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THE JEANNETTE EXPEDITION.

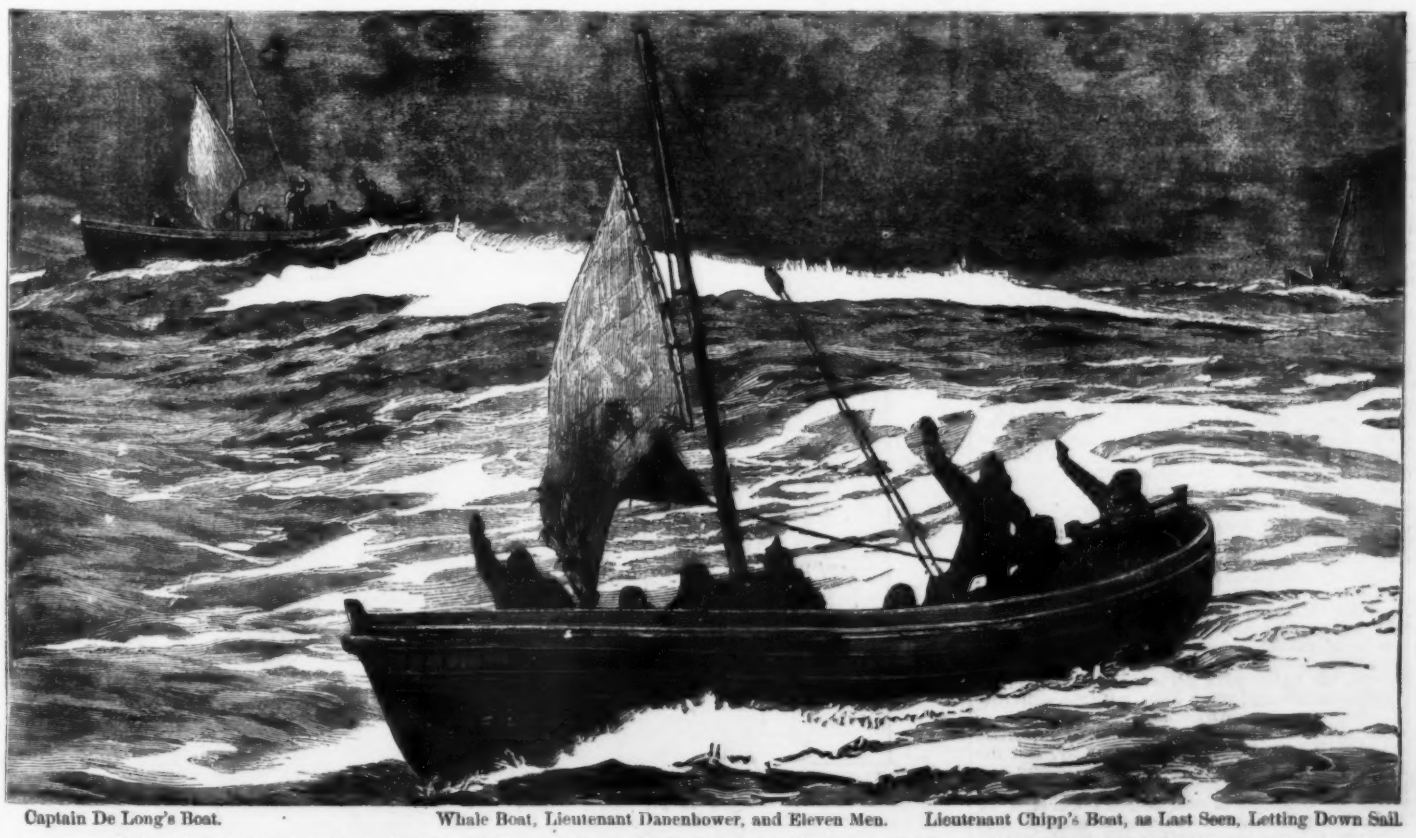
OUR illustrations are from sketches by the artist of the London *Graphic*, made from details supplied to him by Lieutenant Danenhower, who has also furnished the brief account of the journey and terrible sufferings of the crew, which have appeared in some of the journals. It may be remembered that the Jeannette was fitted out for Arctic research by Mr. James Gordon Bennett, and started from San Francisco on July 8, 1879. She was commanded by Lieutenant De Long and five officers of the United States Navy, and carried two scientists, Dr. Raymond L. Newcomb and Mr. Collins, and was manned by twenty-four men. Touching at St. Michael's, Alaska, the ship's complement was increased by forty dogs and two drivers. On August 28, Behring Straits were passed, and East Cape was rounded on the following day, some of the crew landing and making inquiries after Nordenskiöld and the Vega. Cruising along the coast to the westward that explorer's winter camp was found, though the only relics left behind were a few cases marked "Stockholm" and some portraits of Swedish professional beauties. Head was then made for Wrangell Land, and on September 6, Lieutenant De Long found what he considered to be the lead between the Siberian and American ice packs, and directing the vessel from the Crow's Nest entered the pack, where that night they were frozen fast—about twenty miles to the north-west of Herald Island. From this time until July 11, 1881, the unfortunate explorers lived literally embedded in ice, and in daily peril of their lives. Sometimes by the great pressure of the ice the vessel would heel over, while great masses of ice constantly threatened to crush in the sides of the vessel. Frequently great thundering sounds were heard, and where a moment before all had been smooth and level great mountains of ice would have suddenly arisen.

In November the ice began to break up, and half the floe split away, leaving the ship cradled upon her starboard bilge. The only thing carried away, however, was an outhouse built on the floe, and curiously enough this portion of the floe, outhouse and all, reappeared in the neighborhood of the ship another month later. The Jeannette appears then to have got adrift, but in a few days the ice closed in again, and the vessel was once more frozen fast. The pressure of the ice now became harder than ever, and the vessel was only saved by the immense truss by which she was protected. The cabin doors were frequently jammed hard, the deck planking would start from the beams, while the ship's fastenings would crack like rifle shots. At times each man would lie down with his knapsack ready to leave the ship, while dogs and sledges were kept waiting on the ice. Throughout the strictest discipline was maintained on board, and so excellent was the behavior of the men that there was only one punishment—for profanity. Little game was obtained. Lieutenant Danenhower was confined to his cabin for six months with an affection of the eyes, but otherwise the health of officers and crew seems to have been good. In January, 1880, the vessel sprang a leak, and for sixteen months the pumps had to be kept almost constantly at work. On the approach of summer it was hoped that the ice would break up, but it was found that the floe was quietly drifting back the way it had come the previous winter.

LIEUT. DANENHOWER.
(*Sketched from Life.*)

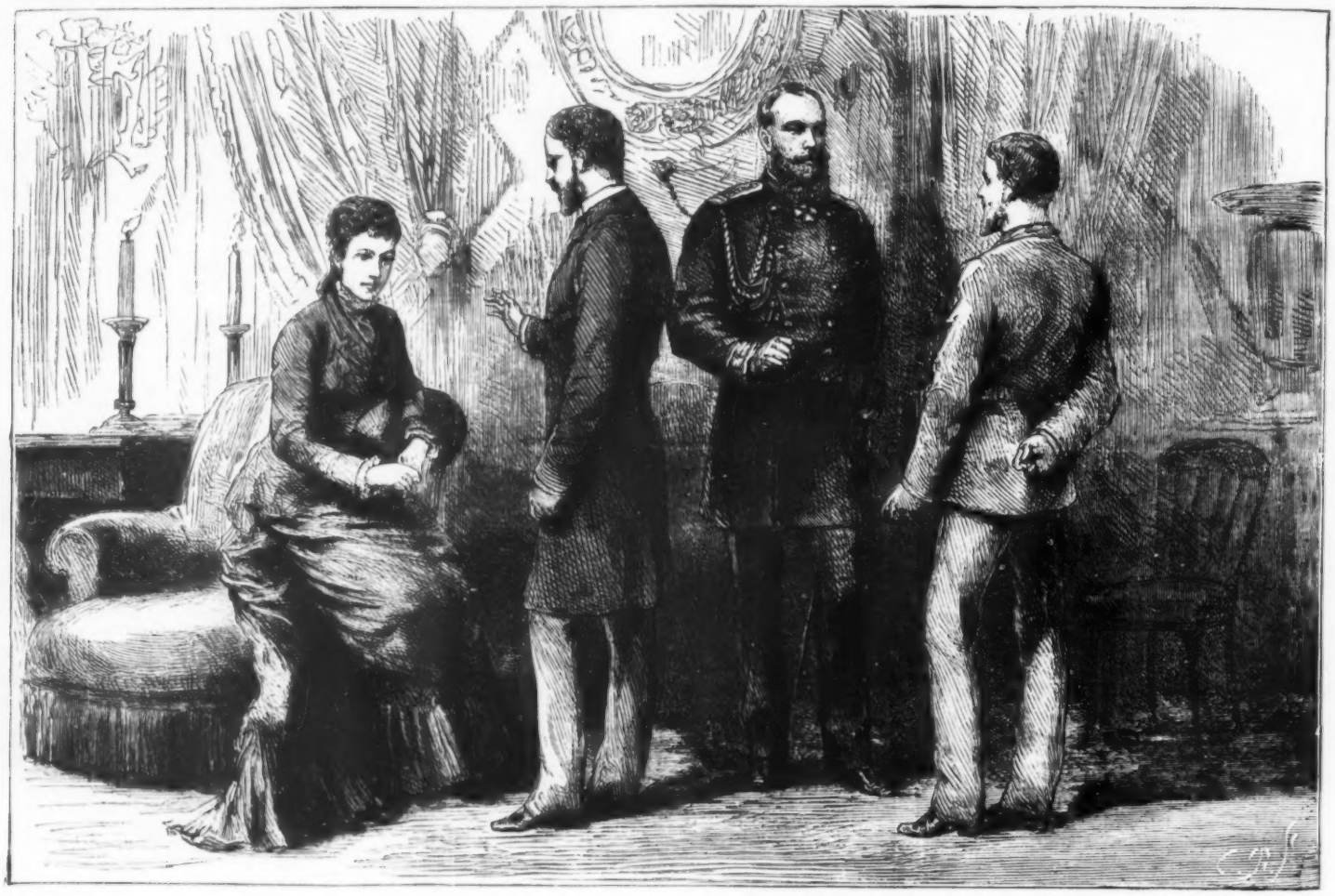
THE COSSACK GUIDE.
(*Sketched from Life.*)

The spring of 1881 found the Jeannette drifting once more over the same track, and on July 11, 1881, came the long delayed catastrophe. Finding that the vessel was in imminent danger, Captain De Long and his crew forsook the ship. "We were not a moment too soon," stated Lieutenant Danenhower, to the *Standard* correspondent. "Dragging our boats to an adjoining ice-floe, we saw the Jeannette's last efforts of resistance. Slowly her sides gave way, and a towering mass of ice fell over and buried her from sight for ever. After a terrible struggle, suffering hardships of nature that no human tongue can tell, we reached open water. Then for one hundred days we continued our journey, keeping our course in the open boats to the south and west, sometimes dragging them over the ice, sometimes wet, always hungry, but still hopeful of reaching land. We had plenty of bad weather. On the night of the 12th of Sept., we had a furious gale, and the three boats were separated. At about dusk the captain stood up in the boat, and made a motion for us to separate. Four days later my boat reached the Siberian coast. . . . Our landing was made near the mouth of the Lena." The three boats in question were commanded by Captain De Long, Lieutenant Danenhower (with Chief Engineer Melville), and Lieutenant Chipp. Captain De Long succeeded in landing at the northern end of the Lena, but not in reaching any inhabited spot, and his body, with those of his companions, have recently been found by Mr. Melville's search party; Lieutenant Chipp's boat was never seen after the gale, and one of our sketches shows it



Captain De Long's Boat. Whale Boat, Lieutenant Danenhower, and Eleven Men. Lieutenant Chipp's Boat, as Last Seen, Letting Down Sail.

THE LOSS OF THE JEANNETTE: SEPARATION OF THE BOATS DURING A GALE, SEVEN P.M., SEPTEMBER 12, 1881.



The Czarina. Lieutenant Danenhower. The Czar. Dr. Newcomb.

THE LOSS OF THE JEANNETTE.—RECEPTION OF LIEUTENANT DANENHOWER AND DR. NEWCOMB BY THE CZAR OF RUSSIA AT GATSCHINA.

in the distance with the sail being let down, the last glimpse of it which was afforded to the survivors; while Lieutenant Danenhower and his companions managed to reach Bolcemga, and were at once taken hospitably in charge by the Russian authorities, and conveyed to Yakutsk. Mr. Melville at once organized and headed a searching party for Captain De Long, but Lieutenant Danenhower and Dr. Newcomb, together with the other survivors, went on to Irkutsk, and thence to St. Petersburg. There they met with the most hospitable reception, being feted by all circles, and were received, on May 2, by the Czar and Czarina. (See sketch.) On Wednesday, May 17, Lieutenant Danenhower, Dr. Newcomb, and their companions arrived at Hull, from St. Petersburg, and at once left for Liverpool, on their way back to the United States. Our portrait of Lieutenant Danenhower represents him in his traveling costume. The Cossack guide is Ivan Alexandrowitch Boschidonoff, of the Yakutsk Regiment, who conducted Lieutenant Danenhower and his companions from Yakutsk to St. Petersburg. —*London Graphic.*

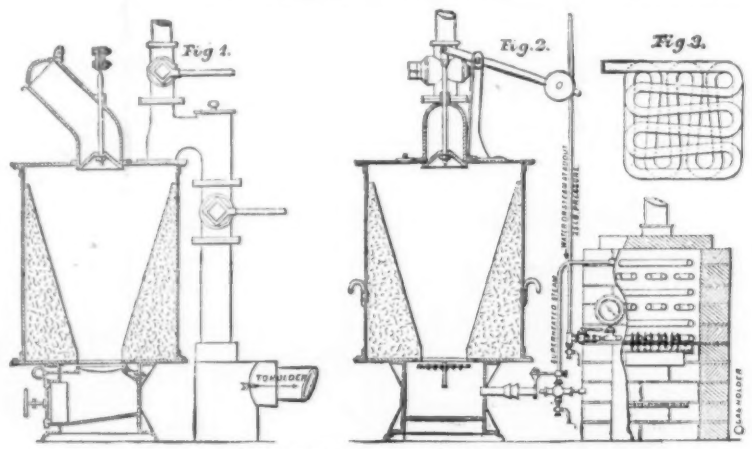
TRIAL TRIP OF THE NEW STEAMER QUEEN OF THE PACIFIC.

STEAMSHIP Queen of the Pacific, built by the Messrs. Cramp, steamed away from the wharf of her constructors on Monday morning, amid the screeches of tug and steamboat whistles, for a trial trip as far as Cape May Point. The Queen, which was under command of Captain Alexander, had on board a number of invited guests, among whom were Chief Engineer Beuhler and Constructor Fernald, United States Navy; O. E. McClelland, of the Pennsylvania Railroad; Dr. Beverly Cole, of San Francisco; J. C. Henderson, superintending engineer of the Oregon Railway and Navigation Company. The average speed made by the new vessel was thirteen knots per hour, but it is claimed that she can easily make three more. The machinery worked perfectly, and when below League Island those on board were greeted with a round of cheers from the British King, homeward bound. A short stop was made, and when Cross Ledge Light had been reached at 5 P.M., the anchor was dropped. Four hours later the ship started for the Capes, which were reached about 11 o'clock. At 5 A.M. yesterday she started for Philadelphia, arriving at her berth, foot of Federal Street, about eight hours later. The vessel was built by the Cramps under a contract with the Pacific Coast Steamship Company, at present consolidated with the Oregon Railway and Navigation Company. She is 352 feet in length, 32 feet 6 inches hold, and 38 feet 6 inches beam. Her engines are 45 and 90 inches by 48-inch stroke, and are of the compound acting, inverted, surface condensing. She developed about 3,000 indicated horse power, and has eight cylindrical boilers, 11 feet in diameter, 12 feet 9 inches in length, carrying from 90 to 110 pounds of steam, with return flues. Her register tonnage is 2,727.

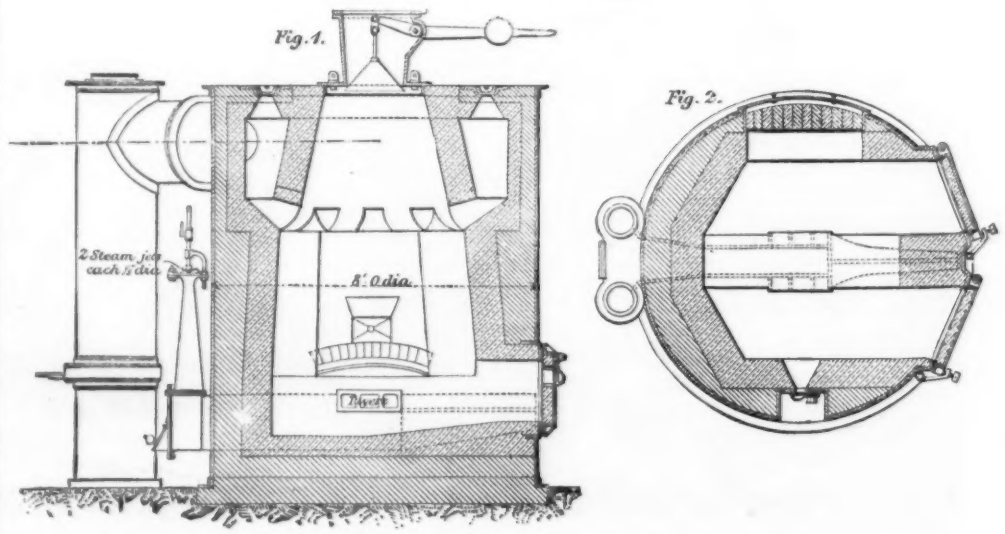
The interior of the new ship is handsomely fitted up, the wood work being of veneer and mahogany, with the social hall finished in the latter work. There are also two bridal chambers of mahogany and white holly, with the walls covered with Japanese paper. An awning deck runs the entire length of the ship, and a promenade deck for three-quarters of its length. The skylights are of mahogany, and the height between decks seven feet eight inches. Every portion of the vessel is supplied with the Edison electric light, and there are also oil lamps in case necessity will arise for their use, and the chandeliers are very handsome. The Queen is to ply between San Francisco and Portland, Oregon, and has accommodations for 190 first-class and 150 steerage passengers. Her cost was about $500,000.

IMPROVED GAS MAKING APPARATUS.

VARIOUS systems of gas producing which are available to the individual consumer, by means of which gas may be produced simply and cheaply for home consumption, without resort to the gas main, are gradually being brought into prominence. In the Dowson gas producer, the furnace, or gas generator, is of a cylindrical shape, tapering down at the bottom in a cone to a small grating, the fuel being fed in small quantities through a hopper at the top. A jet of very dry superheated steam is used to inject air into the generator,



THE DOWSON GAS PRODUCER.



THE WILSON GAS PRODUCER.

for the combustion of the coal into carbonic oxide, the steam itself being at the same time decomposed and its hydrogen liberated. The gas pressure obtained is considerable, depending, of course, upon the pressure of the steam injection, and the volume constantly given off by so small an apparatus seems remarkable. For heating purposes the gas may be used direct from the generator, and may be made from any kind of coal, but for driving a gas engine, it must be made from anthracite and purified, which is done by passing it through a chamber containing layers of iron peroxide in trays. For lighting purposes the gas is made to take up a quantity of mineral oil vapor to furnish the necessary free carbon for the illuminating portion of the flame, but for this purpose it can hardly hold its own as to price with ordinary gas. For heating purposes, however, the price, as compared with coal gas, is about one half, the Dowson gas costing about 3d. per 1,000 ft., and five volumes of it being about equivalent to one volume of good coal gas.

The Wilson gas producer, of which we annex a plan and elevation, from *Engineering*, is similar in principle to the Dowson gas producer, but is on a much larger scale, and is arranged differently so as to burn slack of all kinds, and the resulting gas is adapted only for heating purposes. It is built in the form of a kiln, some 8 ft. in external diameter, and 10 ft. high, the internal diameter being widest at the bottom and gradually narrowing toward the top to a hopper through which the coal is introduced. The mixed steam and air is introduced through a trunk across the bottom of the chamber, and passes into the fuel through six tuyeres. Around the top of the generator passes a collecting chamber through which the gas is taken to the main. The lower part of the generator is periodically cleared of ash and clinker by introducing a series of bars through the sides of the chamber and over the top of the trunk to hold up the fuel, and raking out the mass of refuse which collects in the bottom through the ash-doors. The size of generator above mentioned is calculated to burn 4 cwt. of slack per hour, yielding about 30,000 ft. of mixed gases, the cost of which is estimated at about three farthings a thousand feet. The annexed table shows the composition of three samples of the Wilson gas, the proportions being by volume.

Carbonic oxide.....CO	26·89	23·41	23·60
Marsh gas.....CH_4	1·45	2·22	3·05
Hydrogen.....H	11·55	13·82	10·55
Nitrogen.....N	56·11	55·86	57·55
Carbonic acid.....CO_2	4·00	4·69	5·25
	100·00	100·00	100·00
Total percentage of combustible gas.....	39·9	39·45	37·2

THE VENTILATION OF THE ST. LOUIS TUNNEL.

WE give a plate devoted to the illustration of the method and establishment recently completed, and now in operation, for the ventilation of that bane of the traveling public, the St. Louis Tunnel. Having become dangerous and intensely disgusting in its unventilated condition, and public demand becoming stronger for an amelioration, the company resolved to make the most strenuous efforts to remedy the defect at any cost, with, as will be seen below, the most gratifying results.

An intensely interesting problem to solve, Mr. C. Shaler Smith devoted himself to the task, and bringing a large engineering experience to bear upon it, coupled with unlimited resources, by dint of hard study and practical experiment, he solved the difficulty in a most successful manner. The experience he has acquired in this present case will doubtless

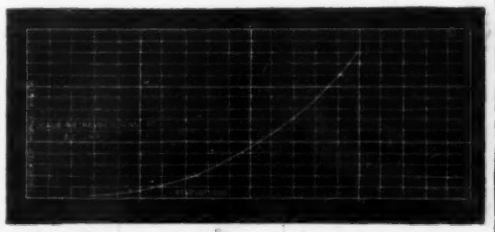
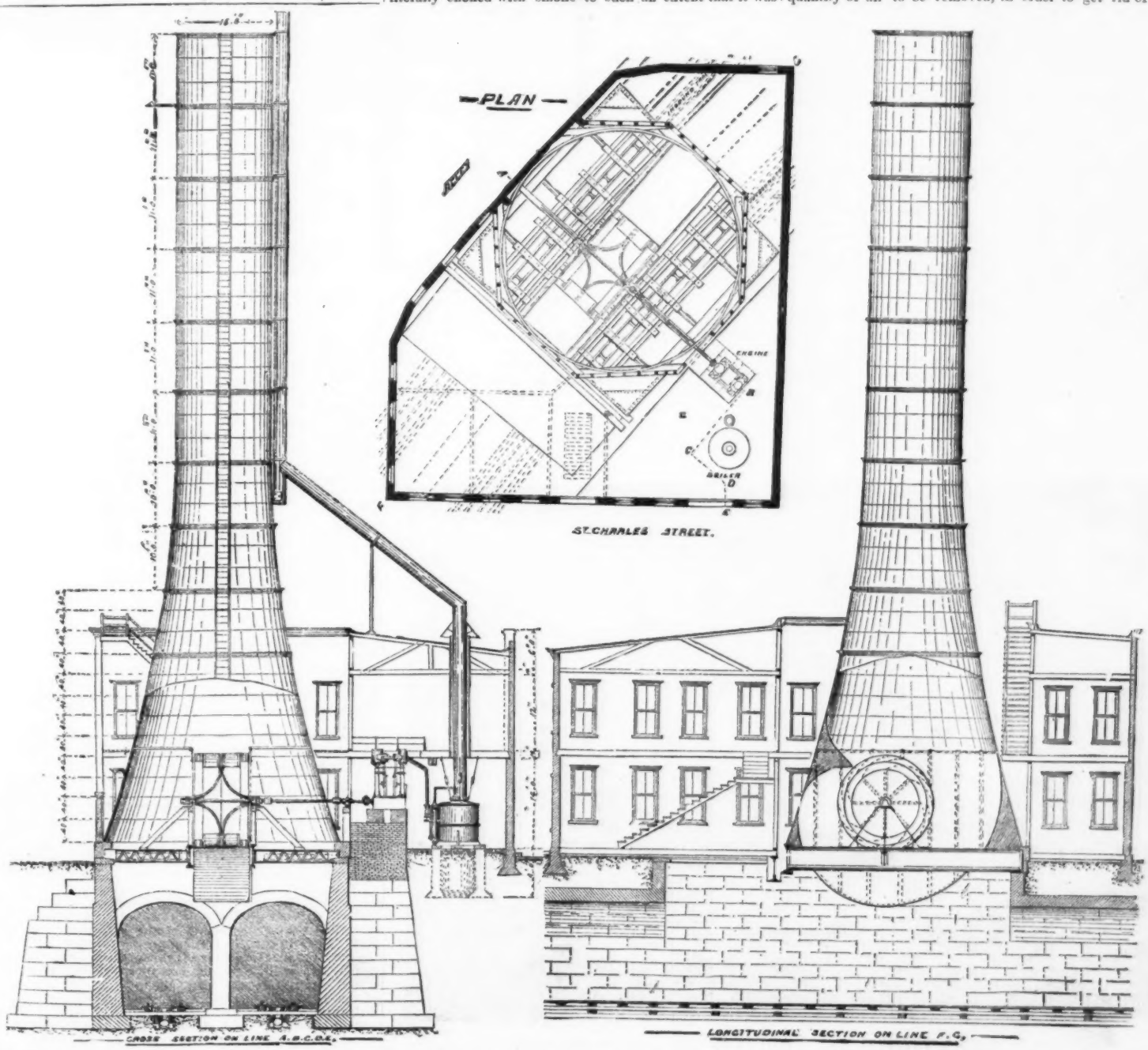


Diagram showing the relation between indicated horse power and number of revolutions for engine running fan at Eighth and St. Charles Streets, for ventilating tunnel, St. Louis, March 29, 1882. C. S. Smith.

go far toward leading him to reliable conclusions, whenever he may be called upon for similar work, and there is a vast amount of such work, calling for immediate attention, scattered over the country.

The St. Louis tunnel is a double track, double archway-passage under the city of St. Louis, and connects the Eads Bridge with the Union Depot. It is 5,007 feet long, has grades varying from 1·37′ per 100 to 0·31′, and contains one curve 90° in length and 500 feet radius. The number of regular trains per diem is 272, and as the engines must necessarily go through with full fires and high steam on account of the curve and grades, and burn a soft, sulphureous bituminous coal, the tunnel has for some years past been literally choked with smoke to such an exient that it was almost impossible to repair the tracks. There were four ventilating shafts, but these proved useless. Coke burning engines were tried, but the amount of carbonic acid gas was still the same, and the tunnel was as much of a nuisance as ever. The general manager, Dr. Wm. Taussig, then gave directions to Mr. Shaler Smith, the consulting engineer, to try mechanical ventilation. Mr. Smith, assisted by the superintendent of the bridge and tunnel, then spent some months in experimenting on large models of various forms of centrifugal fans, air screws, and combined screw and centrifugal machines, and finally reached a conclusion as to the best shape to adopt for this particular case. They likewise made many trials as to the flow of air currents in the tunnel, the friction of air at high speeds over various surfaces, etc. The result of all this we show on the accompanying plate. The fan itself consists of a pair of steel cones placed butt to butt and riveted together. These cones carry the inner blades, 16 in number and 3 feet wide, all of soft steel. These again carry a pair of steel annuli, 26 inches wide, and having riveted to them the outer sets of blades, 32 in number, 16 inches wide, and shrouded by annuli, 13 inches in width. The fan is 15 feet in diameter and 9 feet wide. It is run by a Herreshoff, compound double cylinder, non-condensing engine, the ultimate capacity of which is 192 H. P. The fan discharges into a stack, built of boiler plate, circular in shape, 37 feet in diameter at the base, 15 feet at the top, and 110 feet high. The result has been perfectly satisfactory. Trains run through the tunnel in 4 minutes, and occupy 1¾ minutes in going from the western entrance to the fan house. From the time a train passes the fan house going east it is 4½ minutes before the tunnel is completely clear of smoke, and the smoke from a westbound train is exhausted in 3½ minutes from the time the engine passes the fan house. The tunnel is, therefore, clear of smoke from east-bound trains in 6¼ minutes, and from westbound trains in 5¾ minutes, from the moment either train enters the archway. This is with the fan running at 110 revolutions, a speed which requires the expenditure of 56 I. H.P. At 120 revolutions, requiring 72 I. H. P., the current of air in the western end of the tunnel becomes unpleasantly strong for the repair-men. The fan is run day and night, and the engineers and firemen live in the building erected around the chimney stack. It is found that 104 revolutions of the fan, requiring 48 H. P., is amply sufficient for the requirements of the present traffic in the tunnel.

In order to secure the full advantage to be derived from the use of the ventilator, it was found necessary to shut up all the other ventilating shafts and also to cover in the street bridges, so as to make closed passages of them. Owing to the enlargement of the tunnel where it passes the Custom House, and between Third and Main streets, the total quantity of air to be removed, in order to get rid of the



VENTILATING FAN AND CHIMNEY, ST. LOUIS TUNNEL, ERECTED 1881-1882. C. SHALER SMITH CONSULT. ENGINEER, M. B. GRANT, ASST. ENGINEER

smoke from each train is 2,755,000 cubic feet. Each train, of course, runs to some extent in its own smoke, as the speed of the train is greater than that of the flowing air; but there is no accumulation of smoke, and the engine is usually in clear air. The success of the work is owing not so much to the form of ventilator used; as to the painstaking care with which every part has been designed with a view to the diminution of friction in both the machinery and the air currents. —*Amer. Engineer.*

ELECTRIC LIGHTING APPLIED TO NAVIGATION.

SINCE electric lamps have ceased to be laboratory apparatus, able to operate only during experiments of short duration, to become systems of continuous lighting, there has arisen the serious question of applying them on board of vessels of all kinds.

Mr. Th. du Moncel, in his *Exposé des Applications de l' Electricité*, had already pointed out, several years ago, the immense advantages that the navy as well as the merchant service might derive from the use of the new light for illuminating the way, avoiding collisions, traversing ports in order to land at night, and finally for maneuvering as surely in darkness as in broad daylight. We see in this same work that the first experiments were made with the Alliance magneto-electric machines, about the year 1855, on board the Jerome Napoleon, and then repeated on the Saint Laurent, the Parfait, the D'Estrées, the Heroine, the Coligny, and the France; but, at that epoch, electric beacons had not been devised, the luminous focus being simply installed at the mizzen mast. It was on the Amerique that the first complete trial was made, the lantern having been placed at the top of a turret at a height of about five meters above the deck. The lantern, properly so called, was composed of prismatic glasses, and could illuminate an angle of 225°, leaving the vessel entirely in the shade. The regulator, which was on the Serrin system, was suspended *à la Cardan*. Such an arrangement certainly constituted a serious progress; but still it presented a certain number of difficulties in regard to maneuvering, and so the officers of the Amerique, whom we have often met in New York, have stated to us that the electric light was rarely used on board. But the question has been much studied for some little time past, and we may cite, in passing, the ingenious arrangement devised by Mr. Serrin for sending the luminous rays from an electric focus in all directions. Visitors to the International Exhibition of Electricity certainly remember this hand-maneuvered regulator, which was shown in the grand nave in front of the principal entrance. The combination adopted in this apparatus would render excellent services on a ship.

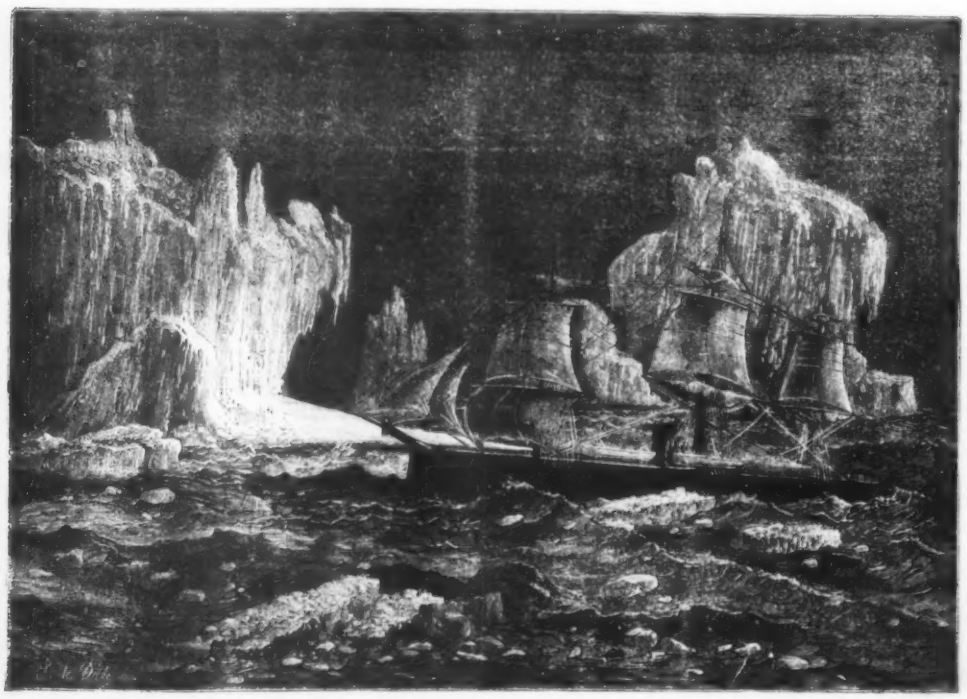
Now, the question of electric lighting is entirely the order of the day in the marine, and we have often cited here the trials and the definite applications which are being made all the time on numerous ships, both with regard to internal lighting (for which incandescent lamps are employed) and to safety beacons, which should necessarily be constituted of foci of a certain intensity.

The period that we are now passing through renders this study of the utmost interest. It is well known, in fact, that every year, toward the vernal equinox, the temperature, upon becoming milder, brings about a breaking up of the polar ices, and the immense fields of the latter, situated in the Arctic regions, after doubling Cape Farewell at the southern extremity of Greenland, are borne along at the moment of breaking up, by a great current, which, occupying the whole width of Davis Strait, descends across the Atlantic and carries with it fields and mountains of ice over the route taken by vessels going from European to United States ports. It is at once a solemn and a sublime spectacle to see the violently agitated ocean roll its waves like mountains against these unyielding bodies; but, when it strikes with violence these masses that it has put in motion, the effect is wonderful, and the results of the collision have a terrific grandeur. At times it bears down upon and buries many feet beneath its waves the blocks of ice, which, rising again to the surface, shed the waters from them in foaming cataracts; while each individual mass, rolling in its bed, strikes against its neighbor and wrestles with it till one is superposed on the other. And it is not within a circumscribed space that such phenomena occur, but they are often observed going on as far as the eye can reach, and over an extent of surface many kilometers square. Unlucky then the vessel which should get entangled in this immense moving chaos, and woe to her if, during her progress at night, she be not provided with the apparatus necessary for avoiding these terrible icebergs, whose shock would be certainly fatal.

The accompanying engraving shows a ship directing herself alongside of mountains of ice, and avoiding collision therewith by the aid of a properly arranged electric light.

We have said that these questions possess all the interest of actuality. We read, in fact, in one of the last numbers of the English journal, *Nature*, that the steamers that have recently arrived at New York, met, on their way, in 45° 48′ North latitude and 47° 48′ East longitude, immense fields of ice; and that the Circassian, it appears, was obliged to bear toward the south for two days in order to avoid them; and that the Saint Germain, which lately left Havre, had the start of them only seventy hours.

C. C. SOULAGES.



ELECTRIC LIGHT AS APPLIED TO NAVIGATION.

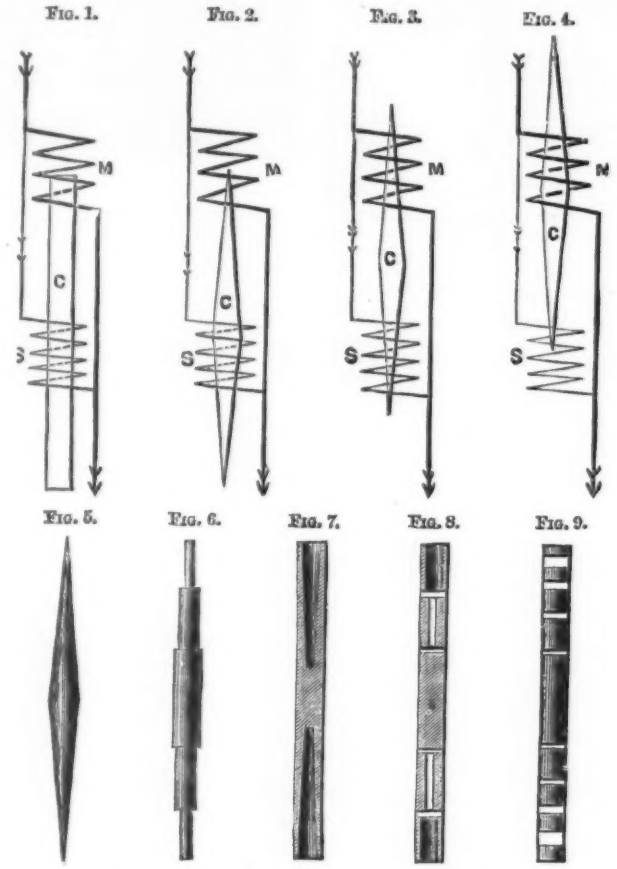
THE "PILSEN" ELECTRIC LIGHT ARC LAMP.*

By HENRY F. JOEL, C.E., A.S.T.E.

THE "Pilsen" electric light arc lamp is the invention of two Austrian engineers, Messrs. Ludwig Piette and Franz Krizik, and is so called owing to the difficulty of correctly pronouncing the names of the inventors, Pilsen being the name of the town where the lamp was invented.

The special and novel feature of this lamp is the use and action of a biconical or spindle-shaped iron core when suspended between, and partly through, the interiors of two magnetic solenoids, placed one above the other, through which an electrical current is passing. When so used, such a core has no positive or balanced position, and can be moved, and will remain in any new position.

When a cylindrical iron core of the ordinary form is placed inside a solenoid coil, and an electrical current is sent through that coil, the iron core takes up a positive and balanced position in the coil, and as is well known, when moved out of that position always tries to regain it. With two coils, M and S, placed one above the other (see Fig. 1 of the diagrams), the cylindrical core, C, will take up a position between the two, exactly in proportion to the magnetic power of each; any alteration of the current passing through either coil will disturb the balance, and cause the iron core to move up or down, and upon the balance being restored the core will return to its former position. The limit of such movement, however, is, in practice, soon reached; while the use of a cylindrical core necessitates clockwork gearing and releasing apparatus of a complicated nature, as instanced in the application of that system in Messrs. Siemens' differential electric light lamp, and others of that type.



THE "PILSEN" ARC LAMP.

* A paper lately read before the Society of Telegraph Engineers, London.

In the "Pilsen" lamp, on the other hand, the double-coned iron core, within the limit of half its length, is not so affected by moving, and has no such balanced position; and thus it has a very long extent of movement, which is utilized directly to feed the carbons in an electric light lamp, and so avoids the use of complicated mechanism.

Fig. 2 shows the double-coned iron core, C, in a similar position, between the two coils, M and S, to that of the cylindrical core in Fig. 1. Fig. 3 shows the core half-way between the two coils. Fig 4 shows the core in the reverse position to Fig. 2. In each and all of these positions, and in any intermediate position, the action upon the coned iron core is the same, and it has no tendency to move up or down.

Figs. 5, 6, 7, 8, and 9 show different forms of core, all or any of which have the same peculiar property as the double-coned core, all being made with the greatest mass of metal in the middle, and gradually tapering or decreasing to almost nothing at their ends, the biconical core, however, being the best of all.

The action of the "Pilsen" lamp with the coned core is the same when placed in a horizontal, or any position.

The uniform action of this peculiar-shaped iron core is due to the equal and opposite magnetic effect which appears as the result from the decrease of the mass of iron in one solenoid being compensated for by the increase of its magnetic action, and *vice versa*, and it is this most interesting feature which constitutes the principal novelty in the "Pilsen" lamp.

Fig. 10 of the diagrams shows a simple application of the biconical iron core and double coils. The top coil, M, is in the main circuit, the positive wire after passing round this coil being connected to the contact guide roller, *r*, and from thence through the frame and tube to the top electrode, and so through the arc to the negative wire which is directly attached to the bottom carbon. One end of the shunt coil, M^1, of fine wire and high resistance, is connected to the wire of M at the terminal at top, the other end of the shunt coil being connected to the bottom carbon-holder; the iron core is fixed inside a brass tube, which again slides inside another brass tube, round which the coils, M and M^1, are wound, the iron core being counterbalanced by the weight, W, suspended from a cord passing over the roller, R, so that the core is free to move up or down to any position. The two coils, M and M^1, are so regulated that, when the arc formed at the carbons is of exactly the proper length, usually two millimeters, the action of the coils upon the core is exactly balanced. Any alteration in the resistance of the circuits by increase of the length of the voltaic arc disturbs this balance, and the iron core with the top carbon attached descends and again restores the balance, and remakes the size of the arc to the predetermined length.

This lamp is essentially an electrical lamp, as contrasted

with mechanically regulated lamps, and as made is extremely simple.

The theoretical examination of this combination of biconical core and two solenoid coils confirms its practical action. The following examination and formulæ are taken from the periodical, *Zeitschrift für Angewandte Elektricitätslehre*, No. 12, 1881 (see Fig. 10):

Let S represent the pull of the main coil, M,
and S^1 that of the shunt coil, M^1.
R the force pulling the carbons together, allowing for the resistance of friction caused by the movement.

The weight of the core being counterbalanced as before mentioned, the inertia of movement is the same in any position.

Let J represent the current passing in the main circuit,
and J^1 the current passing through the coil M.
J^2 the current passing through the coil M^1,
and o — the resistance of M.
a — the resistance of M^1.
y — the resistance of the carbons, and
x — that of the light.

It is to be calculated what function x is of the other variables.

The following formulæ have been determined:

$$S = A J_1 \quad \ldots\ldots 1$$
$$\text{and } S^1 = B J_2 \quad \ldots\ldots 2$$

A and B being constants of the functions of the magnetic movements of the coils.

Further,
$$J = J^1 + J^2 \quad \ldots\ldots 3$$
$$\frac{J^1}{J^2} = \frac{a}{x+y} \quad \ldots\ldots 4$$

from 3 and 4 follow

$$J^1 = \frac{J}{1+\frac{x+y}{a}} \quad \ldots\ldots 5$$

$$J^2 = \frac{J}{1+\frac{a}{x+y}} \quad \ldots\ldots 6$$

$$S - S^1 + R = o \quad \ldots\ldots 7$$

If we substitute the values found as above for S, S^1, and J, J^2, in the examples 1, 2, 5, 6, into and for 7, the result would be

$$A\frac{J}{1+\frac{x+y}{a}} - B\frac{J}{1+\frac{a}{x+y}} + R = o.$$

From this

$$\frac{A}{1+\frac{x+y}{a}} - B\frac{J}{1+\frac{a}{x+y}} + \frac{R}{J} = o.$$

After that,

$$\frac{A\left(1+\frac{a}{x+y}\right) - B\left(1+\frac{x+y}{a}\right) + \frac{R}{J}\left(1+\frac{x+y}{a}\right)\left(1+\frac{a}{x+y}\right)}{\left(1+\frac{x+y}{a}\right)\left(1+\frac{a}{a+y}\right)} = o.$$

Further,

$$\left(\frac{x+y+a}{x+y}\right)\left[A - \frac{B}{a}(x+y) + \frac{R}{aJ}(a+x+y)\right] = o.$$

If we put

$$\left(\frac{x+y+a}{a+y}\right) = o$$

then $$x = -y-a.$$

This result is of no value, being negative, for x can have a positive value only. We therefore put

$$A - \frac{B}{a}(x+y) + \frac{R}{aJ}(a+x+y) = o$$

then
$$(x+y)\left(-\frac{R}{aJ} + \frac{B}{a}\right) + A + \frac{R}{J} = o$$

then
$$x+y = \frac{\frac{R}{J} + A}{-\frac{R}{aJ} + \frac{B}{a}}$$

and
$$x = a\frac{AJ+R}{BJ-R} \quad \ldots\ldots 8.$$

The right side of example 8 contains the two variable elements J and y, and the resistance x of the arc in that case depends upon the current flowing. If we put $y=o$, viz., when the carbons are all burned, then x will be increased in value by the elimination of the resistance of y, and most probably the length of the arc would be increased a little. The correction for this is made by altering the true cone of the core a little only, so that, in fact, examples 1 and 2 are not quite correct. The powers of S, S^1 are also by this alteration made partly depending upon the position of the core.

We can therefore describe example 8 as

$$x = a\frac{AJ+R}{BJ-R} \quad \ldots\ldots 8a.$$

We have still to eliminate the variable element J from the right side. We know from practical test of the friction of the wheel, R, that this variable element can only possess small value when the lamp is otherwise well constructed and worked; from this is to be seen that the alteration of the current passing, and the friction, cannot have much effect upon the arc, still we can eliminate it altogether by making R equal to naught, that is, by making W equal to the weight of the iron core minus the friction-resisting motion. After that equation 8a becomes

$$x = \frac{aA}{B} \quad \ldots\ldots 8b.$$

x is therefore nearly absolutely constant.

The weights of the carbons during each stage of their burning is the same, through their shortening proportionally, and the attendant changing of resistance being compensated by the alteration of the iron core, which is very carefully attended to (we call special attention to this so as to avoid any mistake), the length of arc of such a lamp would therefore be constant. The arc length of a lamp of which x possesses a constant value is a function of the strength of the current; the length of the arc is of course altered by different carbons; we therefore either compensate their varying resistances or use one description only.

The example 8b can in practice be very well used: $\frac{x_2}{a}$ represents, for instance, the loss of current through the shunt circuit; $\frac{x_2}{a}$, therefore, must be as small as possible. A good proportion is 0·04, now the resistance of the light.

With good strong light, each = 0·5 to 1·0 S.U.
" medium..... = 1·0 to 2·0 "
" less..... = 2·0 to 3·0 "
" dividing..... = 3·0 to 5·0 "

As an example, let it be $\frac{x_2}{a} = 0{\cdot}04$, and x_2 4 S.U., a therefore =100 S.U.

Further, we can as nearly as possible, for practical purposes, say $\frac{A}{B} = \frac{m}{n}$ if m and n represent the number of turns on the wire spools.

If a is rightly given above in the proper length, so is accordingly known the size or substance of the wire which has to be used. We can therefore take m to be the same, and with that all dimensions needed for the construction of the lamp are known, and a lamp of constant resistance can be made, a most important result for burning a number in one circuit.

Fig. 11 is a diagram of the electrical construction and connections of the "Pilsen" lamp as actually used. Fig. 12 is a diagram of the automatic cut-out electro-magnet.

The negative wire of the main circuit is connected to the terminal on top at the left, from thence it passes across to

Fig. 10.

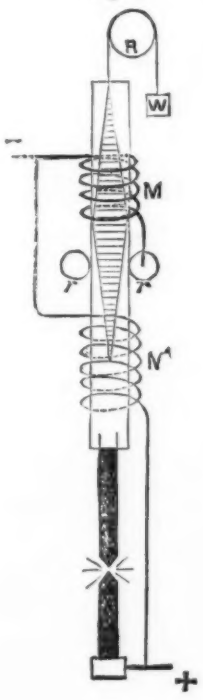


Fig. 11.

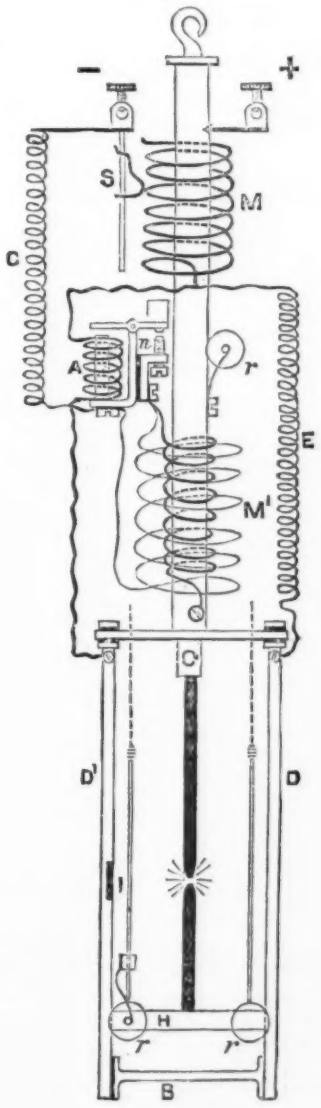


Fig. 12.

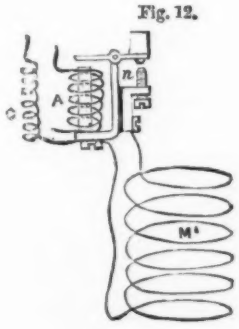


Fig. 13.

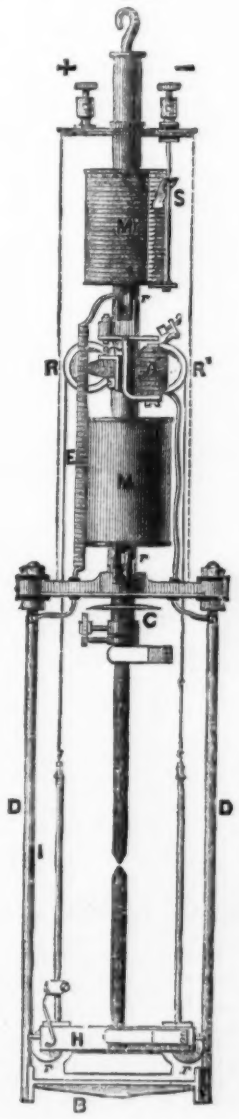


Fig. 14.

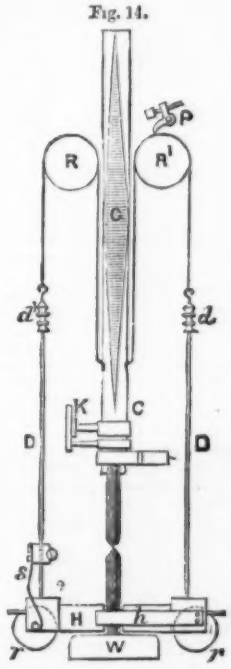
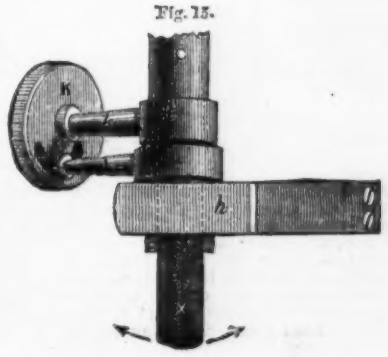


Fig. 15.



THE "PILSEN" ARC LAMP.

the main coil, M, by means of the sliding contact spring, S; after it has passed round the coilings of M, it splits into two circuits, one wire passes round the small electro-magnet, A, and is then connected to the rod, D^1 (insulated from the frame of the lamp), and so down to the contact roller, *r*, and lower carbon and holder, H. The other of the two split wires passes down through a resistance coil of iron wire, E, and is attached to the other rod, D (also insulated from the frame), and then to the lower carbon-holder by the contact roller, *r*. The positive wire enters at the right-hand top terminal, and makes direct contact with the frame and top carbon, thus completing the main circuit through the carbons and arc.

The shunt circuit is connected at the negative terminal,

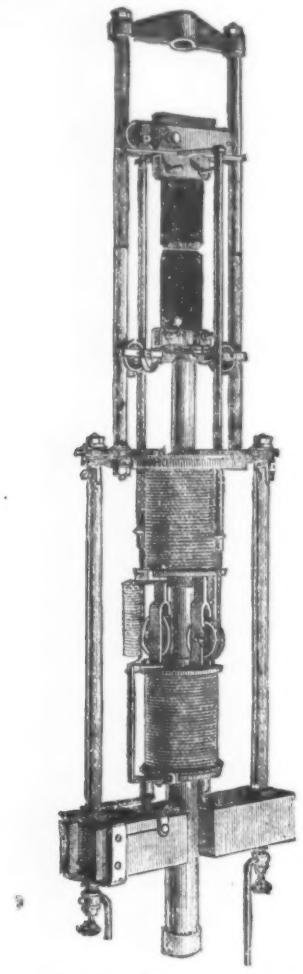


FIG. 16.—THE "PILSEN" ARC LAMP, FACTORY TYPE.

and passes through a comparatively thick German silver resistance coil, G, and then makes contact with the iron frame of the electro-magnet, A; from thence the wire is connected to a fine German silver wire coil of about 13 ohms resistance, wound on the outside of the shunt coil, M^1, the other end of this coil being connected to the contact screw, *n*, and to one end of a comparatively thick copper wire of low resistance which is coiled inside the German silver wire on M^1; the other end of this inside copper wire coil is attached to the metal frame of the lamp, and so completes the shunt circuit, the object of the supplementary resistance, G, being to make up a total resistance with the copper coils inside M^1 about equal to the lamp when burning, and to avoid heating when the main current all passes through that shunt or partial shunt circuit.

This affords a ready method of adjusting the length of the arc, and also regulating the balance should the carbons vary in the resistance. The resistance of the main coil, M, is 0·025 of an ohm, and the difference of resistance afforded by the sliding contact, S, when at extreme ends, is from 0·023 to 0·025 of an ohm.

The use of the small electro-magnet, A (see Figs. 11, 12, and 13), for automatically short-circuiting the high resistance shunt coil on M^1, when the carbons are all consumed, or when there are no carbons in at all, is also interesting. As before described, a split wire from M passes through this electro-magnet. The iron frame of A is made of a bell-crank shape, so that the armature at the top is a prolongation of the bottom pole, thus utilizing both poles. This armature is pivoted in the center, and on its outer end is weighted to overbalance and make contact with the adjustable contact screw, *n*, fixed to an insulated bracket at side of the frame of A. One end of the wire shunt coil on the outside of M^1 is connected to the wire of G, and to the metal frame of A at bottom, and the other end to the copper shunt coil and insulated bracket and contact screw. When the lamp is not burning, the armature of A makes contact with the screw, *n*, and short-circuits the fine wire coil on M^1; the main current then passes through the thick supplementary resistance wire, G, and the inside copper coil of M^1. When the lamp is burning, the main current passes through A, and attracts the armature, and retains it, thus breaking the contact at *n*, and adding the fine wire coil of M^1 to the shunt circuit, which then balances the lamp.

When the carbons are all consumed, the electro-magnet, A, automatically cuts out and breaks the arc: this is done by inserting a small piece of an insulating material in the guide rod, D^1, at I. When the bottom carbon-holder, H, rises to the insulated insertion, I, the roller, *r*, on that side becomes insulated from the rod, D^1, and the electro-magnet, A, is cut out of the circuit, the armature is released, and the weighted side remakes contact, and short-circuits the German silver coil on M^1. The top coil then preponderates and pulls the top carbon up, and so completely separates the carbons, and breaks the arc, the current then passing through the thick shunt coil and wire, G. During this latter operation the supplementary wire and split circuit, E, keeps the circuit through the arc (which would otherwise be broken by the insulation at I), and thus allows the main coil, M, to separate the carbons, and prevent the burning of the metal holders, H and *h* (see Figs. 13, 14, and 15).

The mechanical construction of the "Pilsen" lamp is also very good. The frame of the lamp (see Figs. 13, 14, and 15) consists of a brass tube, mounted between two brass plates, with two iron rods, D^1 and D, joined across at the bottom by the stretching piece, B; the iron core, C (see Fig. 14), is fixed inside a brass tube, which again fits loosely in the tube of a frame, and is guided by contact rollers, *r* and *r*, so that it moves with very slight friction; the weight of the iron core, C, is counterbalanced by the bottom carbon-holder, H, and weight, W, the connection being made by means of the cords and rods, and the pulleys, R and R^1; the metal rods, D D (Fig. 14), being used in the vicinity of the arc. The carbons are fixed as shown, one to the core tube, C, and the other to the holder, H.

One of the pulleys, R^1 (see Fig. 14), has very fine teeth cut in its outer rim, and a weighted pawl or click, P, rests upon the gears into the teeth; the object of this being to restrain the cord which must in one direction rub over the pulley, R^1, and thus serve to arrest the parting of the carbon when there are any fluctuations in the current.

The carbons are fitted and adjusted in a simple manner: they are inserted into the spring clips, *h h*. The bottom carbon and holder can be partly adjusted by altering the lengths of the two side cords; this is done by screwing or unscrewing the nuts, *d* d^1, attaching the cords to the rods. The top carbon can be adjusted to any position by the holder shown at Fig. 15. The spring clip, *h*, is attached to the collar and arm, L, and the two are pivoted at K, and are free to move laterally; above L is a fixed collar and arm, *k*, and on the end of that arm a milled head, K, is free to burn. K has an eccentric slot cut in its face, into which a pin projecting from the end of L is inserted. By turning the milled head, K, the arm, L, and carbon clip, *h*, are moved backward or forward, as may be required. The core tube, C, can also be moved round.

The lower carbon-holder, H, runs by means of the contact rollers, *r* and *r*, between the guide rods, D^1 and D, the contact being maintained by the spring, *s* (Fig. 14). Sometimes a permanent electrical connection is made by a loop of wire attached to the rods, D, and holder, H.

If a fixed focus lamp is required, the pulleys, R and R^1, are made double, one being twice the diameter of the other; the cord that passes over the larger pulley being connected to the top electrode, while the bottom electrode is connected

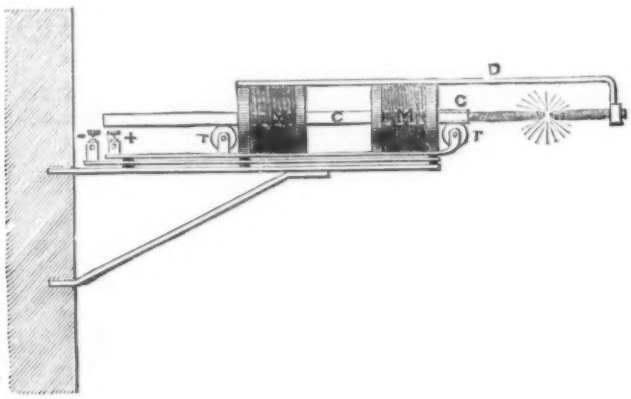


FIG. 17.—THE "PILSEN" ARC HORIZONTAL LAMP.

There are some interesting and novel electrical details in this lamp. The arrangement for altering the length and number of convolutions of the wire on the main coil, M, is, I believe, new, and is effected as follows, viz.: After the wire is all coiled on M (see Fig. 11 and Fig. 13) the insulation is scraped off a strip one-half inch wide all down the outside of the coil, leaving a ridge of bare copper wire; the connection is made through the contact spring, S, sliding up and down the fixed rod, and pressing against the exposed wire, the bottom end of the rod being insulated; by moving S up or down, the length of the coil, M, may be increased or diminished at will, and consequently the pull of the coil, M, to the cord passing over the smaller pulley, the different sized pulleys allowing the carbons to feed together exactly in proportion as they are consumed.

The top of the lamp with the coils is completely encased in a zinc cover box. The globe is put on from below in the hanging lamps (see Fig. 16), and is supported on the ash pan which slides up and down the rod at the bottom. This is very convenient for putting in fresh carbons, etc.

The apparent complication of the "Pilsen" lamp, as made for practical use ("see Figs. 11, 12, 13, 14, and 15), in contrast with the theoretical construction (see Fig. 10), is really a simplification, inasmuch as a workman has no adjustment to make, and no screws to unloose, the electrical and mechanical refinements being specially introduced to render the lamp as nearly as possible automatic in its action.

Fig. 16.—The "Pilsen" factory lamp, which has some novel features.

This lamp is made to burn 100 hours if necessary. The electrical connections are the same as those in the lamp shown and described (Figs. 10 to 15). The small control electro magnet in this lamp is fitted in the top wooden frame at the right side, and is there out of the way of harm. The mechanical construction of this lamp much stronger than the hanging lamp (Figs. 10 to 15); there are two sets of contact rollers, one set attached to the top and one set to the bottom carbon. The principal novelty in this lamp is the use of plate carbons.

Some of these lamps have been in use in Mr. Piette's paper factory at Pilsen, and work remarkably well; they have proved very suitable for factory purposes, where a cheap and reliable light is required.

Fig. 17 shows a diagrammatic drawing of the "Pilsen" horizontal lamp. The iron core, C, is fixed inside a brass tube, and is supported and free to move upon the contact rollers, *r r*; one carbon is fixed to the end of the tube, C, and the other to the pivoted arm, D; the coils, M and M^1, are practically arranged in the same way as in the previously described lamp.

The special advantage of this form of lamp is that it can be used in low-roofed factories, close up to the ceiling. This lamp was shown constantly at work in the Electrical Exhibition at Paris, and burned remarkably steadily.

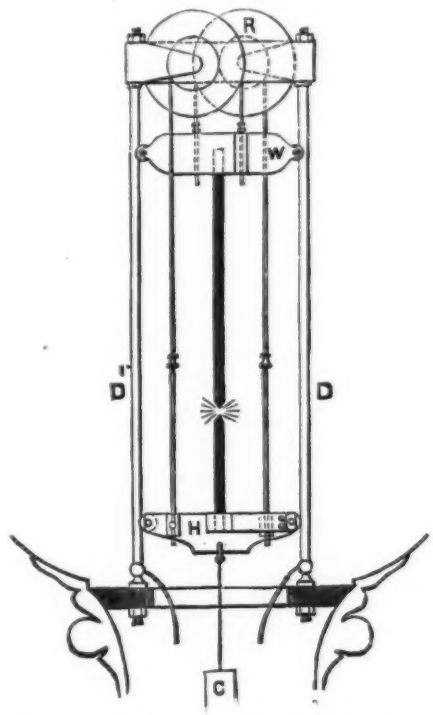


FIG. 18.—THE "PILSEN" ARC LAMP, STREET TYPE.

Fig. 18 shows the "Pilsen" lamp adapted for street lighting.

In this lamp the counterbalance of the iron core is reversed and the coils placed at the bottom, and inside the tube of the top of the lamp; the side rods, D D^1, weight, W, holder, H, and rollers, R, with their cords, are, except for being reversed, the same as the hanging lamp described in reference to Figs. 10 to 15.

This special arrangement of the lamp allows the coils to be placed in safety, and avoids shadows on the globes.

The advantages claimed for the "Pilsen" lamp are:

Its extreme simplicity.

Its almost perfect working.

A steady white light, of good power.

The ease with which the carbons can be fitted.

It has a constant electrical resistance, enabling any number of lamps to be used in one circuit.

It has a continuous feeding movement.

Also automatic appliances provide for all practical contingencies; and a special and distinct advantage is, that it can be worked with almost any description of engine; the absence of all clutches and releasing gear enables the lamp to quickly adjust itself to variations of speed.

The "Pilsen" lamp has been fitted in many places and with unqualified success, and is at present being exhibited in the Crystal Palace, six hanging lamps illuminating the Handel Orchestra; it can also be seen practically at work at Messrs. Wells & Co., Shoreditch, as well as in different parts of the country. On the Continent the lamps have a very large sale, and give great satisfaction.

The six hanging lamps shown are all worked in one circuit from a Schukert dynamo machine, revolving at 850 revolutions per minute, and driven by a Ruston and Proctor single cylinder portable steam-engine, with the ordinary governors. The current passing through the lamps is about 9 ampères, the electro-motive force of the current being about 400 volts, the total resistance being about 45 ohms.

The candle power of the "Pilsen" lamp, such as exhibited, is what is popularly known as 2,000 candles: as this, however, is a matter upon which no two electrical engineers can agree, the author has not given any of the many tests made. The members of the society may judge for themselves by comparing the light of one lamp alone (the other five being cut out) with the gas that ordinarily lights the meeting hall.

To make rubber packing air and steam tight, brush it over with a solution of powdered rosin in ten times its weight of stronger water of ammonia. At first, this solution is a viscid, sticky mass, which, however, after three to four weeks, becomes thinner and fit for use. The liquid adheres easily to rubber, as well as to wood and metal. It hardens as soon as the ammonia evaporates, and becomes perfectly impervious to liquids.

SILICO COPPER WIRE.

L. WEILLER, in Angoulême, recommends the use of this new kind of wire for aerial telegraph wires. It is well known that at the instant when ordinary bronze melts the tin in it forms an oxide which mixes very intimately with the copper molecule, but it has no elasticity at all. By the addition of phosphorus the oxygen is expelled and the tin again becomes capable of crystallizing. In this way a perfectly homogeneous bronze can be obtained which is very tough. In the same ratio as the strength of the wire is increased by the addition of phosphorus its conductivity is reduced, and so considerable is this decrease that although wire made of phosphorus bronze can be used for the telephone it is unfit for telegraph wires. For this reason Weiller sought to replace the phosphorus by a better conductor, like sodium or silicon, and with success. By the new process the metal loses none of its good qualities; it remains homogeneous, solid, and unoxidizable, but it improves a good deal in conductivity. In the silico-copper wire the power of conducting electricity is twice as large as in that of phosphorus bronze. The following table shows the relative strength and conductivity of the new wire as compared with iron and steel wires:

Name of Wire.	Absolute strength for 1 sq. mm. diameter in kilo.	Absolute strength in kilos of wire of following diameter.							Resistance for one kilometer in Siemens Units.							Conductivity compared with pure copper.
		1 mm.	1¼ mm.	2 mm.	2½ mm.	3 mm.	4 mm.	5 mm.	1 mm.	1¼ mm.	2 mm.	2½ mm.	3 mm.	4 mm.	5 mm.	
Pure copper wire	28	21	34	88	137	197	352	549	23	15	5·8	3·7	2·5	1·5	0·9	100
Weiller's new silico-copper wire	70	56	87	219	343	494	879	1374	38	22	9·5	5·1	4·2	2·4	1·5	61
Phosphorus bronze	90	70	112	282	441	636	1131	1766	76	42	19	10	8·4	5·6	3·0	30
Galvanized Swedish iron	36	28	44	113	176	254	452	706	140	90	35	22	15	8·7	5 5	16 5
Bessemer steel	40	31	49	126	196	282	502	785	165	106	41	26	18	10·3	6·5	16
Siemens Martin	42	33	51	132	206	296	528	824	174	111	43	28	19	10·8	6·9	13·3
Galvanized pat. cast steel wire	95	74	116	298	466	671	1193	1864	220	141	55	35	24	13·7	8·7	10 5

The absolute strength of silico-copper wire is somewhat greater than that of phosphorus bronze, but its conductivity is considerably higher. The strength given as 70 kilos per square millimeter (48 tons per square inch) is a minimum value and seems quite sufficient. Since the conductivity decreases as the strength increases, so wires can be made of a diameter of one millimeter, and have a resistance of 48 Siemens units, and an absolute strength of 88 kilos for one square millimeter.

In calculating the cost of a line of silico-copper wire there is not only the advantages that come from using a thinner wire to be taken into account, but also the advantages of this wire over others after the wire is completed.

Iron wire 4 mm. (one-sixth inch) in diameter weighs 220 lb. per kilometer, or 330 lb. per mile, and costs (in Germany) $8 per kilometer, or about $12 per mile.

Silico-copper wire of half this diameter (one-twelfth inch) weighs 25 kilos (55 lb.) per kilometer, and costs about $20 per kilo ($30 per mile). Superficially considered this seems like a very considerable difference in cost, but a telegraph line does not consist of wires alone. As the distance between the poles can be considerably increased there is a saving in poles that amounts to at least 5 in every kilometer (7 or 8 per mile), besides the saving in insulators and in labor. The work of unrolling, stretching, and regulating the wire is lightened by its less weight. According to Weiller the total saving amounts to $16 per kilometer, so that silico-copper wire as compared with iron would not cost over $4 per kilometer. But this price is not half what the wire is worth after it is out of use. In fact old silico-copper wire costs no less than 45 cents per kilo, or $11.25 per kilometer. Taking this as the value of old wire, the cost of renewing a line of the silicated wire would not be as great as that of renewing an iron wire. Old iron and steel wire is known to be absolutely worthless. (This is not strictly correct.)

Then there is the extra labor of building a line of 4 mm. over one of 2 mm. thick, beside the greater stability of a telegraph line made of fine thin wire over that of thicker wire, which offers a larger surface to the wind and snow, and which is liable to break in winter from hard frost, while the finer wire will be much less covered with ice. Silico-copper wire, like that of phosphorus bronze, never require any protection like iron and steel. The zinc used to galvanize iron and steel has a disadvantage, for as soon as the iron is exposed by any injury to the zinc covering, either by accident or a flaw in its manufacture, it is destroyed more rapidly than it otherwise would be. Finally it must not be forgotten that the new silico-copper wire does not stretch like pure copper, but is nearly like steel in this respect. The smaller the diameter of the wire used for telegraphic purposes, the less it will stretch in length, so that another disadvantage that thick wire has is also overcome.

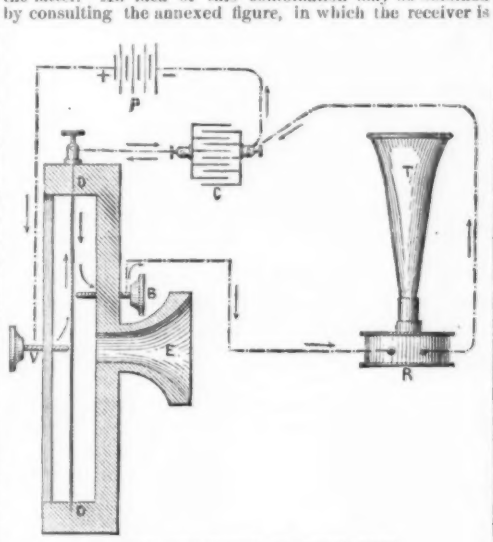
[The conductivity of pure copper and the strength of steel are united in the wire used by the Rapid Telegraphic Co., a core of steel being surrounded by a layer of copper deposited electrolytically.—ED.]

HERZ'S TELEPHONE TRUMPET.

ALL telephone receivers are capable of producing sounds of great intensity when the currents that act upon them are properly combined. It is in this way that Mr. Boudot, of Paris, has succeeded in making a common Bell telephone speak loudly by means of his paper spring transmitter; and it is in this way that a simple Gower or Siemens telephone may be made to reproduce words (badly articulated it is true) by means of a voltaic arc transmitter. Mr. Herz has just demonstrated this fact in a curious way by making of the Gower telephone a trumpet, capable of making itself heard loudly in a very large room, although, as in the Ader system, the tune be only hummed slightly in a species of Reiss transmitter. Scarcely any change has been wrought in the apparatus as they are at present constituted, but the electrical arrangements have been so combined as to produce great effects.

In order to understand the possibility of amplifying sonorous effects by electrical means, it must be recalled to mind that, according to Guillemin's researches, the quantity of electricity furnished by a pile in a given time is so great relatively to that given by static electrical machines, that a condenser of a very large surface may be instantaneously charged with a pile, although a certain length of time would be required to charge the same condenser to saturation with a glass plate machine.

It is true that the tension of the charge will be much greater in the latter case, but the quantity of electricity condensed will be smaller; and, in the actions of the kind that we are speaking of, the effects produced depend essentially upon the quantity of electricity in play. It may be easily understood, then, from what precedes, that by applying large condensers to a telephone circuit it will be possible to obtain quick charge and discharge effects, capable of putting in circulation relatively large quantities of electricity, and of acting strongly on the telephone receivers. This was Mr. Herz's idea; but, in order to apply the principle effectively, it was found necessary that the transmitter should, at every double vibration of the diaphragm, charge and discharge the condenser. This he was enabled to effect by establishing on the two sides of the diaphragm two contacts, one in connection with the pile, and the other corresponding to one of the armatures of the condenser—the diaphragm itself being connected with the second armature of the latter. An idea of this combination may be obtained by consulting the annexed figure, in which the receiver is



HERZ'S TELEPHONE TRUMPET.

shown at R, the transmitter at E, the pile at P, and the condenser at C. The receiver is an ordinary Gower telephone, provided with an acoustic trumpet, T; and the transmitter is a simple telephone mouthpiece, whose diaphragm, D D, is placed between two contact screws, V and B, which are connected, as shown in the figure, with the condenser and receiver.

Normally, neither of the screws, V, B, touches the diaphragm, but, the moment any one sings into the mouthpiece, E, the vibrations to the left have the effect of putting the pile in communication with the two armatures of the condenser by causing a circulation of the current in the direction of the arrows. The result of this is that the left armature of the condenser becomes charged positively through its connection with the positive pole of the pile (through the medium of the diaphragm and the screw, V), while the left armature becomes charged negatively through its direct and permanent communication with the negative pole. On the contrary, the vibrations of the right hand side of the diaphragm, D, D, by suppressing the contacts with the screw, V, and establishing them again with the screw, B, cause the armatures to communicate with each other through the circuit into which the telephone receiver is introduced. From this, then, there results a series of discharges through the receiver which correspond to the interruptions of the circuit brought about by the vibrations of the diaphragm; and these, under peculiar conditions of force, are capable of reproducing the sounds which have caused such vibrations.

The condenser employed by Mr. Herz for these experiments is an ordinary submarine cable apparatus, of an electrostatic capacity, of about seven microfarads, and the pile employed consists of five Leclanché elements.—*La Lumière Electrique.*

LIGHTNING.—LOOK OUT FOR IT.

As the summer advances and the lightning storms may be expected, the exchange manager must look out for trouble following closely in the train of each storm.

Last summer considerable havoc occurred among the Blake transmitters, and many were the induction coils idealized by too close an interview with atmospheric electricity.

Comparatively few receiving telephones and bell magnets were so demolished; it is, however, likely that the mortality among all classes of telephonic helices may be greatly diminished by a judicious selection of apparatus, and by frequent and careful inspection.

In the matter of selection, it is not wise to purchase any magneto bell in which the local circuit is not entirely separated from the line when the telephone is on its support.

It is not probable that any bells are now made utilizing the main line circuit of the bell, as a part of the local transmitter circuit, but the older bells were frequently so made

Many persons who have not been long in the business might, by the low prices asked, be tempted to purchase bells so arranged. To all such we would say, "Don't."

Again, never put up a bell without a lightning arrester.

To be sure the little saw-teeth plates, with which our manufacturers adorn their bells, don't afford much protection to the square inch, but half a loaf is better than no bread; and, if the man who puts up the bell does his share, and unites the ground plate by a *stout* copper wire, without many sharp turns in it, to a water pipe, making the connection with pipe of large surface, having previously brightened the pipe and finishing the job by soldering the connection, you can count the chances in your favor after all. Moreover, the inspectors should about this time keep their weather-eye open, and see that connections are all tight in and about the subscribers' offices.

The great difference between a man and a binding screw is, that a man is no good when he is tight and that a binding screw is no good when it is not tight.

They should also see that the ground wires are in good shape; especially is this necessary where more than one office happens to be on one line. The temptation to omit the lightning arrester ground at the intermediate stations is in such cases almost irresistible. There are, it is true, many constructing linemen who are square and want to do their whole duty, and do it well, but man is but mortal, and with such a temptation, must not be too harshly thought of if he falls. If the lightning strikes a certain wire it of course does so with the laudable idea of going to earth by the shortest and quickest road.

If it has to go through intermediate offices to reach a terminal ground, and at those intermediate offices finds a good lightning arrester ground, some of it will probably jump the space and go to ground at those offices, instead of traveling through all the bell magnets to the ends of the line, pulverizing them *en route*. If it does not find lightning arresters with good ground wires, don't blame it if it burns up your bell magnets in traveling through them. The reason your ground wire should be straight is, that lightning travels at a tremendous rate of speed, and hence, like any other body traveling fast (an express train, for example), has a rooted distrust of its ability to successfully turn a sharp corner, and therefore does not generally try it, but goes straight ahead; therefore, if the inspector finds a crooked ground wire, let him take out the corners, and if it is impossible to make the wires straight, at least he may transform the corners into gentle curves.

The reason your ground wire should be large is, that atmospheric electricity, besides traveling under high pressure, travels in considerable volume, and wants plenty of elbow room. Therefore, if the inspector finds a No. 18 copper wire, he will do both wisely and well if he supersedes it by a No. 11 or No. 9.

The reason the ground wire ought to be firmly soldered to the water pipe is, that if the joint is not a good one heat will be generated there, just as heat is produced in an incandescent light, by the attempts of a large amount of electricity to pass over or through a hard place; and, therefore, to save trouble, it is concentrated wisdom to make first-class ground wire joints.

The reason—that to have a loose connection anywhere about your apparatus is like playing with dynamite and percussion caps on the top of a cook stove—is, that if lightning strikes your line-wire anywhere and comes into an office, it will very likely pass off quietly *via* the "ground wire," and "line out," provided the connections are in good order; but that if it finds a loose connection in its way, the continuity is interrupted, and, as it must go somewhere, it is apt to smash the apparatus and break out into the room in its search for an easier way to the ground than the way through the loose connection.

To conclude, give lightning every facility to escape and it will let you alone, ninety-nine times in a hundred; obstruct it, and it will turn again and rend you!—*N. Y. Review of Telegraph and Telephone.*

COATING PAPER WITH PHOTOGRAPHIC PREPARATIONS.

FEW operations are of much greater importance in connection with photography than the application of uniform layers of various more or less viscous preparations to the surface of paper, and in illustration of this, we need merely refer to albumenized paper, carbon tissue, the various kinds of transfer paper, and the sensitive sheets used for photo-lithographic purposes.

There is every reason to believe that before long a gelatino-bromide or a gelatino-chloride paper will come into very general use for printing purposes, not only on account of the rapidity and ease with which prints may be obtained, but also on account of the fact that such pictures are likely to be much more permanent than the ordinary prints on albumenized paper. We are aware that many correspondents have experienced much difficulty in covering the paper with satisfactorily uniform layers of the sensitive mixture, and we therefore propose to now consider some of the methods which are in general use for covering paper with thick or viscous preparations, and to detail some experiments which we have made on the best methods of coating paper with a gelatinous emulsion.

SUGGESTIONS IN ARCHITECTURE.—ORNAMENTAL DETAILS, DESIGNED BY PROF. A. BRAUSEWETTER, REICHENBERG.—*The Workshop.*

One of the oldest and simplest methods of covering paper is by brushing, and this proceeding answers well when a mucilaginous substance of the nature of gum-arabic is to be applied, as the brush lines flow together rapidly; and by exercising a little care a uniform and bright surface can be easily insured. In other cases application with a brush must be followed by a subsequent polishing or burnishing with a long-haired badger-hair softener, this being held so that only the tips of the badger hairs touch the surface to be worked upon. This method of subsequently polishing with a badger brush or softener is of almost universal application in the preparation of enameled paper and cards, the odinary enamels consisting of flour paste as a basis; a white or tinted pigment being also present, and ordinarily a small proportion of gelatine or glue. Enameled papers are extensively used for the reception of the collotypic impression.

The well-known method of floating finds extensive application in the manufacture of abumenized paper and numerous other photographic preparations, and it is an excellent process when a thin coating is required, and the preparation is sufficiently viscous not to run down toward the lower end of the sheets after they are pinned up. It is, however, not very suitable in the case of gelatinous solutions, because these must be used while warm; and as the paper becomes heated through during the time of floating, the tendency of the gelatine to set rapidly is diminished; when, however, the paper is rapidly drawn over the surface of the gelatinous solution, as in the manufacture of carbon tissue, the case is different, as the paper is not sufficiently long in contact with the surface of the warm gelatinous mixture to acquire its full temperature, the consequence being that the film is cooled to an appreciable extent by the paper itself, and it is usually more or less solidly set at a distance of six or eight feet from the coating trough. Makers of carbon tissue recognize the fact that the more quickly the paper is drawn over the surface of the pigmented gelatinous composition, so much thicker is the resulting film, a circumstance which the above-mentioned considerations explain.

For coating paper with gelatine emulsion, there can be no doubt that one of the usual forms of tissue coating machine would be the most suitable appliance; but as the simplest arrangement of this kind is somewhat complex and troublesome to manage, we may describe two methods founded on the same principle, and which we have found to answer very well on a small scale. The emulsion is made rather thicker than is usual in ordinary cases, and is poured out into a porcelain dish to a depth of about two inches. A strip of paper, which is about an inch less in width than the longer dimension of the dish, and about six feet long, is now taken and rolled up as compactly as possible, the smooth side being outward. The free end is now held while the coil is gently placed on the surface of the emulsion in the dish, after which the end is rapidly and steadily drawn upward so that the coil unrolls on the surface of the emulsion, after which the coated sheet is hung up to dry. Care must be taken that the coil does not come in contact with the sides of the dish during the process of coating, and the speed with which the operation is performed determines, as before intimated, the thickness of the gelatinous layer. A little practice and care suffice to enable one to obtain the most satisfactory results by this mode of proceeding; but if any difficulty is experienced, the paper may be rolled on a tolerably heavy metal roller, and the quantity of emulsion in the dish should be so adjusted as to rise only to a height equal to one-third of the diameter of the roller. In this case the method of working is the same as before, only the roll sinks instead of floating, and the operation of coating must be performed so rapidly as to render it impossible for the emulsion to run to the back of the paper by way of the ends.

Such expedients as coating waxed glass with emulsion, and then stripping the film on paper, are hardly sufficiently rapid and easy for the preparation of a paper to be used for printing or enlargements, but it is quite possible that an adaptation of the "roller" method, largely used in the application of the vulcanizing solution to India rubber fabrics, may be found useful. In this case a small roller rapidly revolves in a trough of the solution, and the fabric is led across the top of this, but in a direction contrary to its movement. This apparatus has long been in use in the rubber factories, and we remember seeing it in action at the Silvertown Works two or three years ago. A special apparatus founded on this principle, and intended to be used in coating plates, has been patented.

A neat way of coating paper, due, we believe, to Mr. Woodbury, consists in placing two sheets back to back, and rapidly drawing them through the preparation; and we have but little doubt that the simple and easily constructed arrangement of Mr. T. G. Whaite, which we described in our issue of last week, will prove of considerable value in coating sheets of paper with emulsion.—*Photo News.*

PHOTO JOTTINGS.

By MAJOR J. WATERHOUSE, B.S.C.

Use of Celluloid.—It struck me some time ago that if flat sheets of transparent celluloid could be obtained, they would form an admirable basis for collotype printing, combining, as they would, the respective advantages of glass and metal transparency, admitting of sunning at the back, and non-liability to fracture. It seemed probable, too, that the opaque variety of this substance, known as xylonite, might be a good substitute for lithographic stone or zinc plates for printing from, as its surface can either be highly polished or grained. Having ascertained that celluloid was manufactured by the British Xylonite Company, I visited their works at Homerton. I found that the only description ordinarily available was the opaque white xylonite, in sheets of various thicknesses, and chiefly used by the company for making combs. This would be a most useful material for carbon transfer work and other photographic purposes; but in large pieces it is almost impossible to get it perfectly flat and free from an obstinate tendency to buckle, a defect which would render it useless for lithographic or zincographic printing. Mr. Merrian, the manager, showed me, however, a small printing block made of the xylonite, and also an etching, which could be printed in the copper plate press. The transparent kind is not often made; but Mr. Merrian kindly looked up two small samples for me. These were, however, so very distorted and uneven that it was useless to try them for collotype. Their strong yellow color was against their employment in photographic work as a support for negatives, and this is a serious objection, for however colorless the plates might be at first, they would be sure to turn yellow in course of time, as stripped collodion negatives do. Notwithstanding these defects, if the manufacture of celluloid could be so improved as to admit of perfectly flat sheets being produced, there is no doubt that it would be of the greatest value to photographers all round.

Spontaneous Ignition of Papyroxyline.—Photographic pyroxyline is usually considered non-explosive, and, as such, stored in a dry state without any special precautions. Two cases of spontaneous ignition which have recently come under my notice show the danger of this practice. A small quantity of papyroxyline was put away dry in a wooden cupboard, and had been left there for about a month. One morning, on a holiday, a servant going to clean the room found the cupboard smouldering. On opening it the papyroxyline was found to have ignited spontaneously. The ignition does not seem to have been attended with any violent explosion, because the doors of the cupboard were not forced open. A body of flame sufficiently intense to fuse the edges of some pewter plates lying on the top shelf had forced its way upward, and set fire to some paper labels on the top of the cupboard. There were a lot of chemicals and apparatus inside the cupboard, but, luckily, no damage was done to them, beyond every article being coated over with a resinous-looking substance having a strong empyreumatic smell. The second case happened with the same papyroxyline. A jar containing about a pound of it had been made over to the photographers for adding to the collodion. When given over it was in a moist state, but was allowed to get dry; after some holidays this also was found in the cupboard burnt out. It seems to have burnt itself away quite quietly, a large quantity of charred residue being left in the jar, and did no other damage. By a most lucky chance, little actual damage was done on either of these occasions; but the possibilities are serious to think of with ether and other inflammable chemicals in the neighborhood. These cases show that pyroxyline should be kept in a moist state, and never be left carelessly about when dry. In the latter condition it is exceedingly liable to decompose and spoil, even though it may not become dangerous. Well moistened with distilled water, it will keep in good order for a long time, and can be dried again with very little trouble.

Removing Mercury Stains from Glass.—After glass plates have been used once or twice with the usual map-copying intensifier of bichloride of mercury and hydrosulphate of ammonia, the surface becomes badly stained, and it is difficult to get clear negatives. In working with the Eder and Toth's lead intensifier some time ago, we found that it was also useful for removing these stains from the old glasses In noticing this method on a former occasion, the soaking of the glasses in the solution was recommended. It is now found better to allow the salts to dry on. The solution used is:

Ferricyanide of potassium	10 parts.
Nitrate of lead	7 "
Water	200 "

This is applied to the glasses on both sides with a sponge, allowed to dry on, and left for at least a week. When required for use, the powdery coating is removed by rubbing the surface well with a damp cloth. The glass is then well washed and drained for use in the ordinary way.

Engravers' Tracings on Copper.—The following simple method of obtaining designs on copper may be of use to engravers for making traces of intricate drawings, etc., on their copper plates. The copper plate ready for engraving, having been coated with the usual sensitive solution of bitumen, is exposed to light under the drawing to be copied, and developed with turpentine in the usual way. When fully developed, the lines of the drawing will be seen in bare metal on the asphalt ground. If, now, a tuft of cotton be wetted with a little platinum solution and rubbed over the plate, the lines will turn black. The asphalt ground being removed with benzole, the drawing will be seen in a

clear, fine, black color on the bright copper ground. Other metallic solutions may be used, but the deep black of the platinum is perhaps the best, and the copper plate is not perceptibly etched by it. The method is only suitable for drawings in line. The same principle may be applied to the ornamentation of metal and glass for decorative and other useful purposes. For bitumen work I have found Husnik's solution of purified bitumen answer very well. It is sold ready prepared, and only requires dilution with turpentine or benzole.—*Photo News.*

THE LATE M. POITEVIN.

THIS distinguished chemist has just died at Conflans, in France, whither he retired some time ago, after many years of arduous work in connection with photographic investigation. His labors were chiefly confined to the elaboration of permanent printing processes, and to him we owe in a very great measure the success that has attended carbon printing and the production of photographs in greasy ink.

As far back as 1855, M. Poitevin recognized the property possessed by gelatinous, gummy, and other similar bodies, when impregnated with a solution of bichromate of potash, and exposed to light, of taking up and retaining a greasy ink, and succeeded in applying the discovery to the perfection of a photo-lithographic process.

By covering a lithographic stone, grained in a suitable manner, with a coating of gum or albumen, mixed with a solution of bichromate of potash, and allowing the same to dry, a sensitive film was obtained, on which a picture was produced by means of a negative. Prints were then obtained by the ordinary lithographic process, the ink adhering to those parts only which had been rendered insoluble by the action of light. On the publication of his process M. Poitevin pointed out that the employment of the bichromate compound might serve for the production of metallic plates in *relief* or in *intaglio*, applicable for use in the arts of engraving and typography, as a film of the material in question, after exposure to light under a negative, was found to resist the action of water in those parts which had been modified by the light; whereas the unaltered portions became swollen when moistened, thus forming a perfect design in *relief* from which a cast could be prepared.

M. Poitevin, as a pioneer in the matter of photo-lithography and collotype printing, received the Duc de Luynes' prize—or, rather, the greater portion of it—in 1867. The total amount offered was 10,000 francs, and of this, something more than 8,000 was awarded to M. Poitevin, who was considered to have most nearly solved the problem for which the prize was instituted—the production of permanent photographs.

M. Poitevin, notwithstanding his success as a photographic experimentalist, was far from being a successful man. At the time he received the Luynes prize, he was obliged to support his family by accepting the humble situation of chemist in the small town of Ahum, in the department of the Creuze. Fortune smiled on him somewhat afterward, but he was never in affluent circumstances. He was the most modest of men, albeit in later years a little soured by reason that so little pecuniary benefit had come to him. We believe he only took out one patent, which was sold to MM. Tessié du Motay and Maréchal for £400, and upon which may be said to be founded collotype printing.

To those who were intimate with him he was a warm and sympathizing friend; but to the outside world his demeanor appeared grave and retiring. He had not occupied himself with photographic research for some time, his last contribution being a printing process combining the use of iron and silver salts, and which will be found published in our columns in January, 1880.

Although he had been suffering for some time, his death (which occurred on the 4th inst.), was so sudden that a scheme projected by M. Leon Vidal and others to invest the funeral with a semi-official character by inviting delegates from the various photographic societies, unhappily fell to the ground. M. Poitevin was 63 years of age.—*Photo. News.*

A NEW METHOD OF PREPARING IODIDE AND BROMIDE EMULSION.

IN a recent number of the *Archiv*, Dr. Liesegang makes some interesting remarks upon the preparation of a sensitive emulsion in the old-fashioned manner with collodion, and he points out how a similar proceeding may be applied to the modern gelatine process. He says: Eighteen years ago I referred to the circumstance that a collodion capable of being used without a silver bath might be prepared by mixing a plain collodion with a saturated solution of iodide of potassium, in which as much iodide of silver had been dissolved as the liquid was capable of taking up. Under these circumstances, the collodion becomes milky or turbid, and it is scarcely necessary to remark that plates coated with it must be soaked in water, to remove the alkaline iodide; and the use of a tannin preservative was recommended. The above-described process may be very much simplified by the modern proceeding of precipitation of the emulsion with water, and re-solution in a mixture of alcohol and ether, the following details being recommended to the notice of those who desire to try the process practically.

The ordinary iodizing solution for a liter of collodion, as ordinarily employed for the wet process, is precipitated with a moderate excess of aqueous silver nitrate solution, and the mixed iodide and bromide of silver is thoroughly washed by decantation, the last wash water being poured off as completely as possible. Powdered iodide of lithium is then added, with constant stirring, until the precipitate dissolves; when the solution is mixed with a liter of plain collodion, or, rather, half a liter of collodion made up with a double quantity of pyroxyline; as by this latter modification the amount of alcohol and ether wasted is reduced to one-half. Contrary to expectation, the collodion remains clear; but the next step, which consists in pouring it into a considerable excess of water with constant stirring, serves to precipitate all solid constituents, except the soluble iodide of lithium. After the precipitate of the flocculent matter has been thoroughly washed and dried, it is dissolved in a mixture of half a liter of alcohol and half a liter of ether; the resulting emulsion being used in the ordinary way, and ferrous oxalate being well adapted for development. The pictures may be easily intensified, after fixation, with the usual pyrogallic acid and silver intensifier.

Gelatino-bromide emulsion may be prepared in a similar manner, the details being as follows: Twenty grammes of bromide of potassium and twenty-eight grammes of silver nitrate are separately dissolved in water and mixed. After thorough washing, the last water is poured off until 140 cubic centimeters remain, and then eighty grammes of powdered bromide of potassium is added. When the whole has dissolved, 28 grammes of gelatine is soaked in the liquid until well softened, after which the heat of a water bath is applied. A clear gelatino-bromide mixture is obtained; but, when it is washed in the usual way, it becomes milky, and, after being once more melted, it is ready for use.—*Photo News.*

[Part II.—Continued from Supplement No. 331.]

AN EXAMINATION OF THE VARIOUS METHODS OF DETERMINING TANNIC ACID.

By NELSON H. DARTON.*

THE next method in order for our consideration is that of Carpeni, as modified and improved by Barbieri. This method was looked forward to as an excellent one when first proposed, and consequently was brought into use almost immediately, as it was very simple in its execution and had a cleanliness and deliberation about it which quickly found favor. That careful chemist, Kathreiner, however, soon examined it, and reported† upon his many and discordant results obtained by its use, and at the same time sought to remedy it by a proper modification, but found that none could be applied. In his investigations he used the decoction of sumac and solutions of the preparation known as "tannin" in the market, and which I suppose did not contain over 90 per cent., if even that, of true digallic acid, and from this a precipitate was formed by the addition of the ammonia. I, however, in this course of investigations, wishing to use a greater variety of tanning agents, used all that I have before mentioned, and arrived at independent or rather confirmatory results, by making a thorough examination of the method under every possible condition which might influence the results, and also, if possible, find wherein the errors lay. My general mode of procedure was thus, using as before, for an example, the decoction of hemlock bark, and was not in strict accordance with the details of the process as published by Bolley in his "Handbuch," but with as much greater refinement as experience had shown to be applicable, the decoction was taken in convenient quantity, an excess of solution of ammonia added, and the precipitate thus forming filtered off. A known amount—which was also an excess—of ammonio acetate of zinc solution was then added, and the bulk of the mixture made up to a certain point by the addition of water; the precipitate formed was allowed to separate as far as possible by standing, and the mixture then boiled down at a low heat in a partial vacuum to exactly half (or other specified bulk) of its original volume, and in a known time, after allowing it to cool thoroughly, the precipitate was filtered off, washed with a measured amount of water, heated to about 80° C., then dissolved in dilute sulphuric acid, titrated with permanganate of potassa in presence of indigo, and the result calculated from the data thus obtained, as in Lowenthal's method. Below is a table of the results obtained in per cents:

No.	Hemlock.	Oak.	Chestnut.	Nut galls.	Sumac.	Catechu.	Kino.	Rhatany.
1	9·30	10·00	5·50	67·00	10·00			
2	12·00	12·50	6·50	69·00	13·50			
3	10·00	9·50	5·20	65·50	11·00			
4	11·00	11·20	7·00	68·20	13·00	Result too unsatisfactory to record.		
5	8·50	9.00	6·00	60·00	9·00			
6	18·60	13·00	9·00	69·00	10·00			
7	11·00	12·00	6·00	66·00	11·00			
8	20·30	15·00	11·00	72·00	20.00			
9	8·50	7·50	6·20	60·00	14·00			
10	3·00	5·20	2·80	47·50	3·50			
Average.....	12·20	10·40	6·50	62·40	12·40	.....	.....	.....
Real value..	7·90	8·22	7.42	61·50	16·25	40·00	72·00	34·00

The difference in the results was principally caused by varying the conditions noted above. The first was obtained by employing all the details noticed, having the amount of zinc in excess a minimum, and conducting the evaporation in the shortest possible time. The second result was obtained by omitting the ammonia treatment and filtration preceding the addition of the zinc solution, and exactly in accordance with the original in Bolley's "Handbuch." The preliminary treatment makes the great difference observable, as quite a fair amount of precipitate is in that way separated which would otherwise contaminate the zinc precipitate. The third result was obtained by titrating the solution before and afterward, the removal of the tannic acid by the zinc, etc., and with the preliminary ammonia treatment and filtration, thus making the method on the principle of Lowenthal's result. Number four was obtained in the same manner, omitting the ammonia treatment, showing by its discrepancy, as before, the necessity of this treatment. Returning, now, to the original mode: In number five the evaporation was only prolonged down to two-thirds of the original volume, and in number six to one-third. Results numbers seven and eight were respectively conducted under the same conditions as numbers five and six, but without the preliminary ammonia, etc. Some blank samples of hemlock decoction were evaporated with the preliminary ammonia down to one-third with every precaution, and a considerable amount of brown matter precipitated, showing how numbers six and eight had been influenced; number nine by evaporating quickly, and number ten as in number one, but with twice as much ammonia zinc solution, and without the preliminary ammonia treatment, etc.

Taking all these together, we observe that the method, although thus having a value of 85 per cent., is entirely too erroneous to be used in any form or application, except when conducted as was analysis number nine, which I will notice below. The causes of the discrepancies are these: The compound formed with the zinc is quite soluble in an excess of the zinc solution. Besides this error in the concentration of the mixture, other matter precipitates besides that which would be thrown down by the ammonia. In boiling the mixture down too quickly, ammonia is evolved, and thus the gallate, etc., of zinc precipitates. This influence is shown by the lower figures of result number nine than of number one. Take this process and modify it by the preliminary treatment with ammonia and filtration; use little or no excess of zinc by finding the quantity necessary by a preliminary treatment; evaporate the mixture down to two-thirds its original bulk and at a moderate rate, and thus the excellent results of number nine are obtained. The tannate of zinc formed in this process, as well as the tannate of copper, are quite free from extraneous matters, when from the first five materials upon the table, but from the three last are much contaminated, and thus the results in the last column, so discordant, were not completed, as nothing would have been gained thereby. Altogether, if this method is executed as I propose, it can be made to yield nearly as accordant and accurate results as Lowenthal's, but hardly as practicable. With spent barks and liquors it yields too discordant results to be recorded, and I am thus unable to draw therefrom my comparison, as I did of Lowenthal's and Hammel's methods.

The next method in order of consideration are the two gelatine methods, the one gravimetric, and thus exceedingly objectionable, the other volumetric. The first of Sir Humphry Davy, once so much used, has become by this time almost supplanted—in fact, since Watts published his researches upon its accuracy, and showed that the precipitate of tannate of gelatine was exceedingly difficult to filter out, it having such a slimy nature; and besides, this being so very soluble in an excess of its precipitants, it has lost favor. Some time ago, however, Stoddart claimed that by the addition of alum to the solutions used, both of the prime difficulties might be avoided to a great extent, and fair results could be obtained, although of not the absolute amount of tannic acid in the material, but between this and the amount available for the formation of leather; thus the results have no value when compared with Lowenthal's or some of the others. I might properly remark here, that it is not desired to express the amount of available tannic acid in the material, but the absolute amount present, from which the other results may be obtained by working the materials into "ooze" and tanning some hides with it; but as this can only be done in a laboratory equipped for the purpose it is unattainable. In the examination of this method a series of five determinations each were made, and the results are shown by the table in per cents:

No.	Hemlock.	Oak.	Chestnut.	Nut galls.	Sumac.
1	5·30	6·20	3·50	50.20	10·00
2	4·20	3·80	3·60	52·00	13·00
3	6·00	5·50	4·90	54·00	11·00
4	3·70	4·50	6·40	51·50	9·50
5	4·50	4·30	5·30	56·00	14·00
Value. Average	4·70	4·80	4·70	52·70	11·50
Value. Real....	7·95	8·22	7·42	61·50	16·25

Catechu, kino, and rhatany yielded too discordant results to be further investigated.

All but one of the causes of these great errors are the same as I detailed under Hammel's method, but without the introduction of extraneous matter, as when using hide. These causes have acted to a much more limited extent in this method, and thus a difference in the results, although not entirely governed by these, as the other cause present here, which is comparatively absent in Hammel's method, that is the solubility of the tannate of gelatine, even in presence of the acids of Lowenthal's method or alum, has acted to such a degree as to make the results of this method as low as some of Hammel's are high. Besides this, it may be well to recall to your attention here that a solution of gallic acid is a very powerful solvent, and especially in relation to this precipitate. The figures for the table were obtained thus: The decoction was taken in measured quantity, mixed with sufficient alum solution and filtered as a slight precipitate was observed to fall. A trial precipitation was first made to ascertain approximately the quantity of gelatine solution necessary, and then to another portion the necessary amount, the mixture, after a violent agitation, was set aside over night and on the next morning filtered, the residue on the filter was slightly, but as thoroughly as possible, washed with sufficient water at 5° C., allowed to drain, dried in the air bath (protected), and weighed in the filter paper, the weight of which, when dry, has been previously ascertained. The results in the table show the method to yield too variable results, as well as too low, and consequently we would set this method entirely beyond consideration. The value as deduced from the figures of the table is about 87 per cent., but varies from this to 33⅓ per cent. With spent barks or liquors the results are still more erroneous. Below are five determinations of the value of spent liquors in absolute per cents:

No.	Hemlock.	Oak.	Sumac.	Catechu.
1	Hardly determinable	0·10	0·90	0·50
2		0·10	0·40	0·60
3	Do.	0·10	0·70	0·50
4	Do.	0·10	0·50	0·70
5	Do.	0·10	0·60	0·60
Value. Average	.....	0·10	0·62	0·60
Value. Real....		0·21	0·27	1·62 1·90

These results, as may be seen, are of little value in research, and from them I cannot reason upon the control which is by this method unattainable. Leaving this method we will now notice the volumetric modification. This method, which is even at this time in use, is nearly as inaccurate and surely as tedious as the one before, even though we avoid the necessity of drying and weighing. The prime difficulty in the execution and accuracy of this method lies in the query, At what point is the gelatine or tannic acid in excess in executing this process? It may be readily shown that the addition of a cubic centimeter of either at a certain point will produce a marked opalescence, and that this point remains fixed until a large excess of either reagent has been added. This, in itself, condemns the method. Besides this, however, the same reasoning as was applied to the previous discussions upon the sources of inaccuracy may be applied here, with the additional remark that the after result is considerably influenced by the manner in which the gelatine solution is added. The tannic acid combines with a certain proportion of gelatine, depending upon the amount of tannic acid remaining in solution, or rather the first portion precipitating contains a much larger proportion of tannic acid than that falling when the amount of the latter has decreased; thus very variable amounts of the titrating solution may be used under varying conditions of dilution and bulk of the object. In obtaining the figures for the table below, the bulks of the standardizing solution and those under examination, were kept equal, as was also their strengths, approximately, and the gelatine solution added in

* Read before the American Chemical Society, May 5, 1882.

† Dingler's *Polyt. Journal*, 237, page 481.

1 c. c. at a time; thus similar conditions existed as far as possible. The first five results were obtained with a standard solution, having 1 gramme to a liter of tannic acid, similar to what is called for in the results, the others obtained in comparison with regular solution used in the other examinations. The outline of the mode of procedure was thus: The decoction in convenient quantity was placed in a beaker on a blackened plate, and the gelatine solution containing five grammes of pure gelatine to a liter of a solution of alum run in in 1 c. c. at a time, at first at intervals of ten minutes, then of twenty minutes, and finally of one hour, when the end reactions were approximately determined by taking out a drop on a glass plate, placed over some black glazed paper:

No.	Hemlock.	Oak.	Chestnut.	Sumac.	Nut galls.	Catechu.
1	3·50	4·00	3·50	10·00	49·00	25·00
2	7·50	6·00	3·90	8·00	54·05	31·00
3	6·20	3·40	6·20	11·00	57·00	17·50
4	4·60	5·50	4·50	9·50	51·00	32·20
5	5·00	4·50	5·50	13·00	53·00	35·00
6	6·40	7·10	4·60	11·00	52·00	29·00
7	4·20	5·50	5·40	13·00	55·00	34·00
8	3·90	6·30	6·40	9·50	53·00	33·00
9	4·70	4·20	3·80	11·20	51·90	34·50
10	5·20	7·30	4·70	11·60	54·80	31·50
Value. Average	5·10	5·43	4·85	10·78	53·20	30·27
Value. Real	7·95	8·22	7·42	16·25	61·50	40·00

The average value thus deduced is 84 per cent.—a little less than that of the others; but the figures are so extremely discordant as to condemn the method as little more than a mere surmise. In determining the strength of spent liquors and barks, the results are even less corresponding. Below is a table of five determinations of spent liquors:

No.	Hemlock.	Oak.	Sumac.	Catechu.
1	trace.	0·15	0·90	0·80
2	0·10	0·20	0·50	0·90
3	trace.	trace.	0·70	0·80
4	0·10	0·10	0·90	0·70
5	0·15	0·15	0·80	0·90
Value. Average	0·07	0·12	0·76	0·82
Value. Real	0·21	0·27	1·62	1·90

All the figures were obtained as in the first five of the preceding table. The next method in order is that of A. H. Allan, or rather Stoddart's modification of it. In the examination of this method the first five series of results were obtained by using swollen gelatine to separate the tannic acid, and in the last five a piece of hide, properly cleansed, bated, and raised. The general mode of procedure was as follows: A convenient amount of the decoction is measured out and the standard solution of acetate of lead added until a drop filtered off ceases to color a mixture of ferricyanide of potassium and solution of ammonia with the characteristic red tint peculiar to an excess or the presence of tannic acid. Another portion of the decoction is then taken and the tannic acid separated from it as far as possible by the hide or swollen gelatine, as the case may be, and the remainder titrated as before. If the method was as accurate as the theory would suggest, no tannic acid would be left in the solution after the treatment, and thus no end reaction attainable; but as sufficient tannic acid does remain the end point is readily found. If the absorption of the tannic acid by the gelatine or hide was not so extremely tedious, and the errors noticed under Hammel's method introduced, the method would rank far above Lowenthal's, as the end reaction before noticed is perfectly perceptible when only a one-thousandth part of tannic acid is present; and besides this it is somewhat more tedious and unsatisfactory to be necessitated to filter off portions continually for observing the end reaction. The results shown in the table below are very fair, but too high in the first five series and of no value at all in the others.

Number.	Hemlock.	Oak.	Chestnut.	Nut galls	Sumac.	Catechu.	Kino.	Rhatany.
1	9·50	10·00	9·00	69·0	19·50	47·0	82·0	36·5
2	9·50	10·00	9·50	68·0	21·40	44·0	76·0	39·0
3	9·80	10·00	8·50	69·0	....	.....	74·0	....
4	9·60	11·00	10·00	67·0	.....	.....	.....	....
5	9·40	10·50	9·00	67·5	.....	.....	.....	...
6	7·10	6·50	11·00	52·0	14·30	51·0	64·00	42·0
7	11·60	9·30	6·00	67·0	21·00	38·0	.....	29·5
8	12·60	6·90	4·30	49·5	19·00	.. ..	.....	....
9	6·40	8·40	9·20	57·0	....	.....	.....	....
10	9·20	11·10	7·00	67·5	.....	.....	.....	....
Value. Average	9·37	9·37	8·35	63·3	19·10	45·00	74·0	37·0
Value. Real	7·95	8·22	7·42	61·5	16·25	40·00	72·0	34·0

Altogether these figures give a value of 90 per cent. With spent liquors the results obtained are still more fluctuating. Below is a table of the results obtained, showing it to be of no value in this connection and but little better than Hammel's, etc.:

No.	Hemlock.	Oak.	Sumac.	Catechu.
1	1·50	2·00	4·00	3·50
2	1·50	2·50	4·50	3·50
3	2·00	2·00	3·75	3·50
4	1·25	2·00	4·00	.....
5	2·00	2·25	4·00	.....
Value. Average	1·65	2·15	4·50	3·50
Value. Real	0·21	0·27	1·62	1·90

If the tannic acid could be separated by more appropriate means than with hide or gelatine, this method would yield better results than any ever proposed. The next method in order of consideration is that of Clarke and Jean. These methods were examined just sufficiently as from the results to reject them without further consideration; but I might remark that besides being impracticable they are very inaccurate and yield results having a value of not over 60 per cent. Clarke's method, using cinchonia, I believe might be so modified as to be capable of useful application; but that of Jean's, the iodine and starch method, is of little or no value, the principal error existing, the same as in Allan's method, with a separation of the tannic acid between the titrations; but as this method required six titrations, the first two for the approximation and the others for the two final determinations, it is impracticable. I am, however, to investigate Clarke's method to modify it as to yield the proper results, if possible.

To Mitterszway and Terreil we are indebted for the most ingenious and purely scientific method of determination, and one yielding far better results than any which are generally used. The method, as some of you know, consists in the deduction of the amount of tannic acid present by the amount of oxygen it is capable of absorbing and combining with. This method, however, has the insuperable disadvantage of having a very difficult mode of procedure, and only successful under the careful manipulation of experienced hands, thus rendering it impracticable, except under special circumstances. Some time ago, but not in view of this paper, I examined into its accuracy exhaustively and formed the above conclusions. In time I propose to modify this method, if possible, so as to render it more simple in detail. Lastly, we come to the modification of Lowenthal's and Fleck's method, which I proposed some time ago. I have given this method a most thorough and prolonged series of examinations, carefully controlling the results with working tests on a large scale. As it would necessitate too much space to detail the entire result of my investigations, I will only give a portion of them, fairly and impartially selected, and from those executed upon the same basis as the preceding ones. I will not detail my mode of procedure in this method, as I have frequently discussed them with you before, but I will here note that the preliminary treatment of the decoction with dilute sulphuric acid is absolutely necessary, as the ellagic acid interferes with the other precipitation; and also would I call attention to the necessity of a preliminary treatment with ammonia, as in Carpeni's method. The results are shown in the table.

No.	Hemlock.	Oak.	Chestnut.	Nut galls.	Sumac.	Kino.	Catechu.	Rhatany.
1	7·80	8·10	7·50	59·5	17·00	76 00	45·00	37·00
2	7·85	8·10	7 50	59·0	16·50	74·00	45·00	35·50
3	7·75	8·15	7·50	58·5	16·90	76·00	45·00	38·00
4	7·95	8·25	7·45	59·0	16 75	75·00	45·00	37·00
5	8·05	8·20	7·50	59·0	16·40	76·00	45·00	39·00
6	7·85	8 10	7·40	59·5	15·95	74 00	44·50	36 00
7	7 80	8·30	7·35	60·0	16·20	75·00	46 00	36·50
8	7 90	8·25	7·45	59·0	17·00	75·00	45·00	35·00
9	7·75	8·10	7·40	60·5	16·50	74·00	45·00	37·00
10	7·70	8·20	7·50	58·5	16·50	76·00	46·00	36·50
Value to fulfill control. Average	7 83	8·15	7·45	59·2	16·57	75·20	45·15	36·70
Value to fulfill control. Real	7·95	8·22	7·42	61·5	16·25	72·00	40·00	34·00

I will not mention anything further here of it, except that it has a comparative value of 95 per cent., and much above any of the other methods, and at least slightly above the oxygen method of M. and T. With spent liquors and barks the results are equally as satisfactory. Below are two tables, the first of liquor, the second of bark:

No.	Hemlock.	Oak.	Sumac.	Catechu.	Hemlock.	Oak.
1	0·20	0·250	1·50	1·95	1·50	0·90
2	0·20	0·260	1·50	2·00	1·40	0·95
3	0·19	0·250	1·50	2·00	1·50	0·90
4	0·21	0·280	1·55	1·90	1·50	0 90
5	0·20	0·250	1·50	1·95	1·40	0·90
Value to fulfill control. Average	0·20	0·255	1·51	1·96	1·46	0·91
Value to fulfill control. Real	0·21	0 270	1·62	1·90	1·50	0·90

Taking all these figures together, and comparing them with the actual working tests, as I have under the two first methods, it will be found to be exact, or within 5 per cent. of what it should be. Thus, this method has yielded the best results, and, as before, will be used by me in all the tanning researches I am about to commence.

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EARTH METALS CONTAINED IN SAMARSKITE.

By H. E. ROSCOE.

THE probable existence of a new metal in this mineral was announced by Delafontaine in 1878, and confirmed by him shortly afterward, when it was named Philippium. The most characteristic salt is the soluble formiate, which is deposited in well defined rhombic crystals, and indeed is the only means (except its constant atomic weight) of distinguishing this metal from terbium or yttrium. Terbium formiate is a white powder, while yttrium formiate is much more soluble, and usually deliquescent. The author has investigated the subject, starting with 1,500 grms. of samarskite; he obtained about 60 grms. of oxides containing philippium, terbium, yttrium, and traces of erbium. These oxides were converted into formiates and a most elaborate series of fractional precipitations, etc., carried out in order to obtain the pure philippium salt, but the author entirely failed in procuring an oxide having an unalterable atomic weight of 122. The numbers varied between the atomic weights of terbia and yttria. The following conclusive experiment was then tried: 3 grms. of terbia having an atomic weight of 147·9 and 3 grms. of crude yttria with atomic weight 101·4 were respectively converted into formiates. Of each of these two formiates, two-thirds were brought into solution separately, while the other third of the terbium formiate was mixed with the remaining third of yttrium formiate, and the mixture dissolved. Each of the three solutions was then mixed with an equal bulk of alcohol and allowed to stand for the same length of time. The two solutions, containing respectively terbia and yttria, gave crystals presenting the ordinary appearances of formiates of terbia and yttria, but the third solution, containing the mixed formiates, deposited rhombic prisms, which could not be distinguished from the supposed formiate of philippium. These results prove that the mixed formiates of terbium and yttrium are capable of crystallizing together in a form ascribed to philippium.

PEROXIDE OF HYDROGEN.*

By Dr. P. EBELL.

ACCORDING to the researches to Schoenbein ozonized oxygen is said to be the active principle in grass bleaching. Later and extremely exact researches by Emil Schoene have, however, proved, in conformity with the opinions of A. Houzeau and Fr. Goppelsroeder, that ozone is not engendered in the air during the process of bleaching, but rather, that all the reactions ascribed to the influence of ozone are due to the action of peroxide of hydrogen. Continued quantitative analyses to ascertain the air's titer of peroxide of hydrogen led to the perception that it depends in a great measure on external circumstances, such as the time of year and day, the movements of the air, etc., and Schoene is of opinion that the preponderating influence in its production must be ascribed to the light.

Atmospheric precipitations, particularly hoar-frost, originating under certain conditions, contain considerable quantities of peroxide of hydrogen, namely 0·04 to 1 milligramme in 1 liter of liquid.

The quantities that came to earth within four months amounted to 6·29 milligrammes per square meter.

Although "grass bleaching"—bleaching with water, light, and air—has been exercised with success for thousands of years, and though there was no lack of time and labor for the perfection of the process, yet there cannot be any misconception as to the fact that it is attended with considerable inconveniences. The result of grass bleaching can never be predicted with absolute certainty, especially within a fixed time. The usual way of bleaching mostly requires a great deal of time, and is attended, besides other drawbacks, with great loss of interest.

It will be sufficient to point to the extremely interesting operation of wax bleaching. There is lying at the wax bleachfields near Celle, material to the value of hundreds of thousands of marks, waiting for sunshine and wind. The consideration of these drawbacks will suffice to demonstrate how necessary it is to produce the bleaching medium of nature, the peroxide of hydrogen, in a concentrated form.

Chemistry has at its disposal a long series of combinations which contain oxygen only loosely bound, and which transfer it by their own decomposition to other bodies. These media of oxidation offer a base for the compensation of the oxygen of the air in bleaching, and the following are being technically used: nitric acid, nitrous acid, permanganic acid, chloric acid, chromic acid, and lastly the chloric gas in combination with bases, in the shape of bleaching salts. However manifold these bleaching media may be, the use of all of them is attended with inconvenience, as they more or less injuriously affect the fiber to be bleached, and for this reason their application is limited and difficult. It is the peroxide of hydrogen alone which does not act in that way; it contains the effective agent operating in grass bleaching in a concentrated form, and is therefore superior to all other bleaching media, and in so far must be marked as the bleaching media of the future.

The peroxide of hydrogen was discovered in 1818 by Thénard, who obtained it by the action of acids on peroxide of barium in the presence of water. Thénard showed that the oxygen of the peroxide of barium operated as an oxidizer on the water.

$$xH_2O+BaO_2+H_2SO_4=xH_2O+H_2O_2+BaSO_4.$$

A great number of chemists afterward occupied themselves with the peroxide of hydrogen: Pelouze, Duprey, Balard, J. Thomson, E. Schoene—all found the above way for its production the most preferable.

The resulting solutions are always of a titer of only 5 per cent. peroxide of hydrogen. The separation of the pure product, H_2O_2, is proportionately difficult, on account of its great tendency to decompose. There are two ways for effecting concentration: (1) Freezing out; (2) Evaporation in a vacuum over sulphuric acid at a temperature of 15° to 20° C. (59° to 68° F.).

The pure peroxide of hydrogen is a sirupy liquid of 1,453 sp. gr., which yields a 475-fold volume of oxygen in its decomposition. Dilute solutions equal solution of chlorine in their effect, and will keep for months in a temperature not exceeding 25° C. (77° F.) if protected from the influence of light. A trifling addition of acid has the effect of diminishing very considerably the tendency to decompose. On the other hand, alkalies and salts producing basic reaction hasten its decomposition.

This tendency of the peroxide of hydrogen to lose its oxygen places it among the media of oxidation. It is not in every case that the real reasons are known for the peroxide of hydrogen quickly surrendering its oxygen. There is a series of bodies which accelerate the evolution of oxygen, without themselves apparently undergoing a change. For instance, all pointed, angular, sharp objects, precipitates, such as alumina and hydrated peroxide of iron, charcoal, as well as several metals when very finely grained, as silver, gold, platina.

In the second series of cases the peroxide of hydrogen acts in the same way as any other medium of oxidation in yielding its oxygen to another body. In course of this process arsenious acid is oxidized to arsenic acid, sulphides are converted into sulphates.

Thirdly, peroxide of hydrogen can apparently exercise a reducing action, losing a portion of its oxygen in decomposing other oxidized bodies. In this manner it reduces the peroxides of lead and of manganese to oxide and protoxide.

In general it may be said that the peroxide of hydrogen has a deoxidizing action on acids which have an inclination to yield their oxygen (permanganic acid), and an oxidizing action on oxides in alkaline solution which have the opposite tendency.

Application of the Peroxide of Hydrogen for Technical Purposes.

Almost every one who has treated of the subject of peroxide of hydrogen has predicted for it great future importance; the characteristic reactions almost obtrude themselves upon one's observation.

Dumas ("Handbook of Practical Chemistry," Nürnberg, 1830, vol. i., page 119) had used it for cleaning discolored oil paintings and valuable drawings. Starting, as he did,

* A lecture delivered by Dr. P. Ebell, at a meeting of the Branch Society of German Engineers at Hanover. From the *Industrie Blatter*, January 7, 1882. Reprinted from the *Chemical News*, February 17, 1882.

from the consideration that the fading of the paintings arose from the discoloration of the lights put on with white-lead through the formation of sulphide of lead, and having regard to the regeneration of the latter by the influence of peroxide of hydrogen into white sulphate of lead, success could not but follow the trials. In spite of this, however, the peroxide was not made use of for a long time; it was only in 1870 that an intelligent perfumer employed it, making it an article of commerce in shape of a 3 per cent. watery solution, as a means for bleaching the hair, and under various names, as: "Eue de fontaine de Jouvence, golden," "Golden hair water," "Auricome." About the same period prominent men drew attention to the faculty of reaction possessed by the peroxide of hydrogen as a recommendation for its use in medicine, as A. v. Schroetter, R. Boettger (*Annals of Chemistry*, 1873, p. 365), then Geiger ("Handbook of Pharmacy," i., p. 213, 4th edit). Hager also gives methods for its production in his "Pharmaceutical Practice."

In spite of all this peroxide of hydrogen played only a subordinate part, especially in medicine, the reasons are to be found on the one hand in the slighting treatment which was accorded to it by practical chemistry; on the other in its own most valuable and specific peculiarities, which in certain directions were antagonistic, and which to superficial observation seem still inimical to its being taken into general use.

In the first place the production of the peroxide of hydrogen, so far as regards quantities and purity of the article, was until lately an unsolved problem.

What practical chemistry could offer were only solutions charged with impurities in the shape of various salts and acids, and of the most uncertain and varying composition. For this reason alone, uniform thorough success in any direction could not be attained. But besides that, the price could not be but enormous in consequence of the disability to fully exhaust the materials used in its manufacture and an entire want of demand for the article. These drawbacks are now overcome, and peroxide of hydrogen can be had in watery solution with a titer of 3 per cent. by weight, or of 10 volumes, in a uniform, chemically pure state at low prices and in large quantities.

The doubts with regard to durability and to transport to distant parts may be considered as solved.

The watery solution corresponds in its conditions to solution of chlorine; when light is excluded, and temperature does not exceed 25° C. (77° F.), it loses only a trifling amount of its entire titer of peroxide of hydrogen, and therefore the "peroxide of hydrogen question" must be considered answered with regard to its first part, comprising its chemical production and its capacity of undergoing unharmed the difficulties of transport.

Peroxide of Hydrogen as Bleaching Material for Products of Animal Origin.

All products which are to be subjected to a bleaching process by peroxide of hydrogen must be submitted to a preparatory treatment, the purpose of which is to render them capable in every part of being moistened by a watery solution of the peroxide of hydrogen. Every particle of fat, sweat, and impurity adhering to the objects to be bleached must be taken away.

Besides bathing in a solution of good soap, solutions of 3 to 5 per cent. of carbonate of ammonia have in the first place shown themselves of value; in various cases new means of solution, such as sulphide of carbon, benzene, ether, etc., have been found available.

With regard to the process of bleaching itself, two different principles can be brought into operation.

The watery solution of 10 volume peroxide of hydrogen is neutralized as far as possible by some drops of liquid ammonia and used directly as a bleaching bath.

For a continued process of bleaching it is advisable to use a series of baths, through all of which the object to be bleached passes systematically, commencing with the weakest. Light must be excluded, and temperature not be allowed to exceed 25° C. (77° F.).

The second method is based on the same principle, but carried out in a different way.

The objects preliminarily prepared as above stated are steeped in the solution of peroxide of hydrogen. After being fully impregnated with the liquor, they are taken out and subjected to a process of drying in a current of air, which must not exceed a temperature of 20° C. (68° F.).

The process of bleaching progresses energetically during the evaporation of the water, and the concentration of the solution of peroxide of hydrogen occasioned thereby.

It is a matter of calculation, or depends upon other circumstances, whether the one or the other proceeding is to be carried through.

Bleaching of Hair with 3 per cent. Solution of Peroxide of Hydrogen.

The hair is digested for twelve hours in a solution of 3 parts carbonate of ammonia in 100 parts of water at a temperature of 30° C. (86° F.), rinsed, then washed with soap, and all the fatty matter removed with the help of a fresh solution of carbonate of ammonia. Benzene can also be recommended. Prepared in this way, it is immersed in a bath of peroxide of hydrogen, fully neutralized with liquid ammonia.

It either remains in the bath until sufficiently bleached, or is dried in a room at ordinary temperature and the immersion repeated.

The baths must only be considered fully exhausted when some drops of permanganate of potash produce in the liquor a permanent red coloration.

It has not been found feasible to bleach black hair so that it becomes perfectly white, its color only disappearing so far as to arrive at a light golden fair hue. Even a jet black Chinese tail does not resist.

The bleaching of hair even on living persons does not present any difficulties. After the desired degree of bleaching has been arrived at, an after-treatment by washing with water, followed by a wash with alcohol, takes place; hot liquids or drying in drying chambers is excluded.

Bleaching of Feathers, especially Ostrich Feathers.

As a means of bleaching feathers, the peroxide of hydrogen is far superior to all other substances proposed for the same purpose, and has proved itself of value in every way, especially for ostrich feathers.

Its superiority rests especially on the oxidation and thorough removal of coloring matter, without the slighest detriment to the structure of the feather itself.

By way of preparation the feathers are placed in a bath of carbonate of ammonium containing 1 to 2 parts of salt in 100 parts of water, where they are left for twelve hours at a temperature of 2 ° C. (68° F.), being gently moved about in the bath the while.

After this they are being steeped and moved about in a lukewarm bath of Marseilles soap, and at last well rinsed with water exempt from lime. Boiling or hot liquids must be excluded.

Treatment with pure benzene and ether has also shown very good results.

For feathers it is only admissible to bleach in baths, which must be made neutral, and not be prepared and kept in metal or wood vessels. Earthenware or stoneware vessels are the best adapted for the purpose.

In cases where the feathers are for a long time exposed to the influence of slightly acidulated liquid, there occur, as with all other organic matter, appearances of wasting away in the liquid; they begin to show signs of decay, and lose their beauty to a great degree.

The bleaching finished, the feathers are slowly dried in a low temperature and in moving air, while being repeatedly beaten. At higher temperature the formation of gluey matter easily takes place, in consequence of which the finest fibrals stick together; beating acts as a preventive to that drawback.

It was formerly proposed to dust the feathers while still in a damp state with hair powder, and then only to dry them. The powder acts on the feathers in a similar way as do tanning materials in tanning; like these it prevents the tendency to flaw.

Very favorable results may be obtained by steeping the bleached and still wet feathers in alcohol; this makes the gluey insoluble formations settle down, and the liquid evaporating at very low temperature, it leaves the feathers of a wooly and beautiful appearance. By steeping the feathers in benzene, and allowing it to evaporate, the same end is gained with even better results.

The further treatment of the feathers, as scraping, trimming, and curling, can only be mentioned here in passing.

The success of the bleaching of feathers in the above manner is thorough in comparison with other proceedings. Even entirely black spots are bleached after continued action of the bath.

Bleaching of Silk with Peroxide of Hydrogen.

For bleaching silk a whole series of strong oxidizers, as permanganic acid, chromic acid, nitric acid, have been proposed, and besides them sulphurous acid has been used to advantage. As is the case with beeswax, the coloring matters of raw silk are capable of resisting bleaching materials in different degrees; some sorts of silk are easily susceptible to their influence, while others resist it strongly.

Among the latter is the product of the wild silkworm, the so-called Tussah silk, a fine and durable thread of strongly pronounced brown color.

According to our trials, peroxide of hydrogen is the best means of bleaching this silk, the objectionable brown color being reduced by its action to a but little distinguishable, pleasing yellow. After the boiling of the gum by subjecting the raw silk to a treatment with soap baths of various strengths, and final boiling in concentrated solutions of soap, it is recommended to treat it with carbonate of ammonia.

After that the scoured silk must be subjected to the action of peroxide of hydrogen, in the same way as mentioned under the heading of "bleaching of hair."

Alcohol, eventually mixed with a little glycerin, has in this case also shown itself of value for an after-treatment.

Bleaching of Ivory and Bone.

Records as to the bleaching of bony substances and ivory are very scarce.

Almost universally the process of bleaching in sunlight by means of air and water, which is very trying to the bone, is had recourse to; for ivory chloride of lime has been proposed.

The purpose of the preparation of the bone is, as in the case of all the other substances heretofore mentioned, the removal of fatty matter. While formerly they were treated with steam under pressure, and the fat skimmed off, there have lately been patents taken out for using solvents, such as sulphide of carbon, ether, benzene, and it is said that their use offers advantages as compared with the former way of proceeding, not only with regard to quality and quantity of fatty matter, but also in consequence of the loss of gelatinous substances being only trifling.

Lyes of carbonates of alkalics must be more or less excluded for the above purpose, but weak solutions of carbonate of ammonia may be used.

The bones freed from fatty matter are immersed—preferably while in a primary state of manufacture—in an almost neutral solution of peroxide of hydrogen, and left in this bath as long as may be requisite. The process of bleaching takes place smoothly and safely; even spots of blood in the pores acquire a perfectly white appearance.

Ivory is treated in exactly the same way as bones; fans, handles of walking sticks, and knife handles, bleached by peroxide of hydrogen are already being used very extensively.

Application of Peroxide of Hydrogen for Medicinal Purposes.

The peroxide of hydrogen has not hitherto played a conspicuous part in therapeutics. The reason for that may be, that formerly pure and durable solutions were not to be had at a reasonable figure. Price, however, is no longer an impediment to its use, and the tendency of the peroxide of hydrogen as at present obtainable to decompose can be considerably restricted; possibly peroxide of hydrogen turned into simple water may formerly have led to wrong conclusions. Peroxide of hydrogen if preserved in the dark, and in a temperature not exceeding 25° C. (77° F.), keeps unaltered for months. For ascertaining its titer of active oxygen a normal solution of permanganate of potash is requisite; it would be advisable to fix a minimum titer of active oxygen. It is to be supposed that peroxide of hydrogen, like chloride, bromide, and permanganate of potash, is poison to the smallest organisms (bacteria); exact comparative experiments with a view to ascertain this are much to be desired, considering the importance of the matter. Experiments with yeast instituted by the lecturer had very favorable results, and proved that the germs of the yeast are entirely killed by peroxide of hydrogen, even when greatly diluted.

As regards the fitness of peroxide of hydrogen for treating wounds, caused by syphilitic, scrofulous and tuberculous ulcers, favorable experience has been gleaned by a physician at Hanover. It is probable that peroxide of hydrogen will do good service in the shape of spray in making operations and ligatures; this would be important, considering the effect which carbolic acid spray often has on operators and patients.

The great advantages possessed by peroxide of hydrogen, as compared with other media of disinfection, are:

(1) Complete absence of smell.

(2) Yielding oxygen without leaving any other residuum but pure water.

(3) Absence of injurious influence on the organism.

The workmen occupied in making the peroxide of hydrogen get exceedingly delicate hands, and wounds heal visibly under its influence.

There further seems room for employing the peroxide of hydrogen as a means of disinfecting sick chambers and generally for purifying the air. It would be advisable to spread by means of a rafraichisseur spray of diluted peroxide of hydrogen by way of trial.

Attention must also be drawn to the use of peroxide of hydrogen in dentistry, as has in the first place been done by C. Sauer (*Quarterly Review of Dentistry*, 1879, No. iv.). Sauer made use of the peroxide of hydrogen with success in bleaching discolored and carious teeth. In cases where the teeth are covered with colored matter (*Lichen dentalis*, etc.), he employs peroxide of hydrogen in conjunction with finely levigated pumice-stone as a means of cleaning, in place of water. Teeth, the native channels of which were filled with colored matter, became somewhat paler after several applications. A suitable liquid for cleaning teeth and mouth is prepared by mixing 1 part of 3 per cent. peroxide of hydrogen with 10 parts of water. In case of carious teeth the peroxide of hydrogen on wadding was locally used with advantage.

ON THE ELECTROLYSIS OF SULPHATE OF COPPER.*

THE immediate object of this research was to examine various conditions connected with the transmission of electric currents through solutions of salts of copper, and to ascertain the influence of those conditions on the electrochemical equivalent of copper, also to observe for any signs of conduction of electric currents by such liquids without electrolysis. In many of the experiments some difficulty was experienced in ascertaining the exact loss of weight of the anode, in consequence of finely divided copper falling from it. The powder which fell off, exposing as it did a large surface to the liquid, was somewhat oxidized, and also in acid solutions freely dissolved, and its true weight, and therefore the exact loss of the anode, could not be found.

Among the results obtained were the following: that a porous partition in a solution of sulphate of copper affected the deposit only by preventing the products set free at the two electrodes becoming mixed together; a large surface of cathode diminished the amount of deposited metal, by allowing more copper to be redissolved by ordinary chemical action the effect of diluting the liquid with sulphuric acid was to slightly diminish the amount of deposited copper; diluting the solution either with water, glycerine, propionic acid, solution of sulphate of sodium, borax, boracic acid, or of ammonic alum, had very little effect (and that variable) upon the amount of deposit; much less copper is deposited per unit of current in a hot liquid than in a cold one; without the influence of an electric current, a copper plate dissolved fifty six times faster in an ordinary depositing solution of sulphate of copper at 180° F. than at 50° F.; the amount of copper deposited by aid of a current in such a liquid at 50° F. was about 18 per cent. greater than at 180° F.; with an electric current of small density, and a sufficiently corrosive liquid containing a very small amount of dissolved copper, no deposition of copper takes place; instead of an electric current protecting a copper cathode from chemical corrosion, it indirectly increases that corrosion; a sufficient rise of temperature (viz., from 50° F. to 180° F). was nearly twice as influential as the electric current in increasing purely chemical corrosion; the purely chemical corrosion of a copper anode in ordinary sulphate of copper-depositing solution, is less than that of a separate piece of copper without a current; the loss of the anode is greater than the gain of the cathode in nearly every instance, and this difference is slightly greater with near electrodes than with distant ones; reduction of temperature is a most influential circumstance in diminishing the chemical corrosion of the two electrodes, and making their alterations of weight, by electrolytic action, approximate to each other; purely chemical corrosion of the copper is not entirely prevented by using a pure and cold solution not containing any free acid; the inequalities of loss and gain of the two electrodes are largely, if not wholly due to purely chemical action; there exist relative degrees of chemical corrosive power and strength of current, at which the influence of the two are equal, and a copper cathode neither dissolves nor receives a deposit in an acidulated solution of sulphate of copper containing a very small amount of dissolved copper salt; the amount of copper deposited is not sensibly affected by the presence of a small amount of green sulphate of iron in the solution; nor by the exposure of such a solution freely to the air or to the light; differences of relative position of the electrodes to each other affect slightly both the amount of total loss of the anode per unit of current, and also the relative amount of such loss to the amount of gain of the cathode; the presence of a considerable quantity of persulphate of iron in the solution affects perceptibly the amount of deposited copper, but that of a moderate proportion of nitrate of copper in the solution had no conspicuous effect of the kind; the chemical corrosion of sheets of copper in pure acidulated solution of sulphate of copper was not directly proportionate to their amount of surface, but was relatively less upon the larger surface; the amount of copper deposited per unit of current did not vary much with the magnitude of the cathode or the density of the current; a very feeble thermo-electric current caused a cold copper anode to lose a little more, and a hot cathode to lose slightly less, than without the current; stirring the solution increased slightly the loss of weight of the anode per unit of current, and diminished to a small extent the gain of the cathode; stirring a pure acidulated solution of sulphate of copper increased the proportion of loss of weight of copper by ordinary chemical corrosion without an electric current from 0·07 grain to 0·17 grain, or from 0·411 to 1·0, but in a less proportion if a current was entering the copper as a cathode; a considerable degree of density of current appears to be favorable to enabling a nearer approximation to be made to the true electro-chemical equivalent in the weight obtained of deposited copper.

Many of the experiments indicate, and the whole of them are consistent with the general inference, that in nearly all cases of electrolysis, the two forces, ordinary chemical and electro chemical, coexist and operate independently at the same surfaces of liquid and metal; that ordinary chemical action, both of simple oxidation and of corrosion of both electrodes by free acid, takes place in all cases, and is a phenomenon essentially distinct from, and independent of, electro chemical corrosion of the anode and deposition

* Abstract of a paper read before the Birmingham Philosophical Society, January 26, 1882. By G. Gore, LL.D., F. R. S.

upon the cathode. The two classes of phenomena, however, are coincident, and affect each other in various indirect and secondary ways.

In consequence of these two actions being essentially distinct and independent of each other, an electric current passing out of a piece of copper into an acid solution does not directly increase the rapidity of ordinary chemical corrosion of the metal, nor does a current entering from such a liquid into a copper cathode protect in all cases that metal from such corrosion.

Some of the experiments show that stirring the liquid increases the ordinary chemical corrosion both of the anode and of the cathode, and therefore that the technical process of swaying to and fro by mechanical means articles which are being plated in a depositing solution tends to corrode them.

That temperature also greatly influences the chemical corrosion is proved by the numerical results. The higher the temperature the greater was the amount of chemical solution of the hot copper without current, and of the hot electrodes; and for equal rise of temperature, the increase of corrosion appeared to be greater at high temperatures than at low ones, because the corrosion itself produced heat.

A considerable deficiency of deposited copper, sometimes amounting to 18 per cent., may result by ordinary chemical corrosion through employing a hot solution. This fact is worthy of consideration in the electro deposition of copper for commercial purposes.

The greatest obstacle to finding the electrochemical equivalent of copper was the difficulty of determining how much the ordinary chemical corrosion was decreased at the anode or increased at the cathode by the electric current, and the next greatest obstacle was the disintegration of the anode, and the dissolving of the powder by chemical action. Notwithstanding that the cathode is more corroded by purely chemical action than the anode, the gain of weight of the former is the least inaccurate, because of the unavoidable disintegration of the anode. Substantially the method does not admit of a great degree of accuracy, because the chemical corrosion of copper, even in a cold neutral solution of cupric sulphate, causes a loss of that metal, and prevents the true weight being obtained. The correction cannot be accurately, but may be approximately found by using a comparison sheet of copper in the same liquid without a current. The corrosion of such a sheet is, however, somewhat less than that of the cathode. The nearest approach to the true number appears to be obtained by using a cold neutral solution, small narrow horizontal electrodes, and rapid deposition without stirring, continued during only a short period of time.

No signs were observed in any of the experiments of ordinary electric conduction unattended by electrolysis.

The results of this research also afford information respecting the degree of accuracy of the method of measuring by means of electrolysis of a solution of cupric sulphate, the amount of electric current consumed in electric lighting, and states the conditions under which the degree of inaccuracy of such a method of measurement is the least. It is a remarkable circumstance that an electric current entering a copper cathode from a strong mixture of sulphuric acid and water, instead of protecting the copper, actually increases its chemical corrosion; by what means it does this is now being investigated by the author.

TRIPOLITH AND ARTIFICIAL SANDSTONE.

THE German technical press has lately given attention to the qualities of tripolith as a material for building purposes. The advantage is claimed for it of being an advantageous substitute for plaster as well as for cement. For stucco work, the price of tripolith per centner (110¼ lb.) is about 3s. 9½d., while that for building purposes, the cost is about 1s. 11d. for the same quantity. According to Dr. Petersen, who has dealt with the subject in detail, the preparation of tripolith for use is similar to that employed in the cases of plaster

The German patent gives the following as the process of manufacture: Three parts of gypsum, with traces of alumina, are united with one part of silicious clay, and nine parts of this mixture are mixed with one part of furnace or gas coke. When gas coke is used there should be for each ten parts of that substance an admixture of six parts of smithy scales. The mass when mixed is slowly heated in a vessel up to 120 degrees centigrade (248 degrees Fahrenheit), and afterward up to 260 degrees centigrade (500 degrees Fahrenheit), for the purpose of expelling the water contained in it. The gray substance thus obtained is passed through a cylinder sieve of four millimeters (0·15 in.) size of meshes, which is made to move at a quick rate to facilitate the rapid cooling of the mass. A sieve 14¼ ft. cubic measurement is emptied in three minutes. Reference is made to the English patent as showing the composition of tripolith to be described as follows: A mixture of 9·5 parts of sulphate of calcium, one part of coal dust, and 0·6 of a part of smithy scales.

Dr. Petersen recently analyzed a sample of tripolith for building purposes, dried at a temperature of 100 centigrade (212 degrees Fahrenheit). The following result was obtained, which, in a general way, corresponds with a previous analysis of Herr Treumann, published in a Russian technical journal:

Sulphate of lime	74·90
Carbonate of lime	4·61
Carbonate of magnesia	4·15
Soluble silicic acid with some alumina	1·35
Potash and soda	Traces.
Oxide of iron	0·54
Free carbon	11·44
Water	2·86
Insoluble in muriatic acid (sand)	1·40
	101·25

According to the foregoing analysis, it will be seen that tripolith is gypsum, with an admixture of carbonate of lime, carbonate of magnesia, and sand; this combination being burnt with about one tenth of its own weight of coal or coke. Its properties correspond in a great degree with those of plaster of Paris. It has not a resistance to water greater than that possessed by gypsum, and the time it takes to harden varies according to the method of preparation, and the quantity of water employed. The due proportion of water is a matter of primary importance in the use of tripolith, as an excessive quantity delays the hardening for hours; while if too little water be added the composition hardens before the operation of mixing is fully completed.

The question as to whether tripolith is in all cases an effectual substitute for plaster has been discussed at length by certain authorities of eminence on the Continent, Herr Treumann (to whose analysis we have alluded) maintaining that such is the case, while the experiments of Professor Vogt have led him to an opposite conclusion. The trials made by Dr. Petersen are of interest, in conjunction with his analysis, as quoted above. He chose sand such as is used for trials of mortar, cleanly washed quartz sand of such a size that the grains would lie on a sieve of 120 meshes per square centimeter (0·39 of an inch), and would pass through a sieve with 60 meshes to the same space. Of this sand he added three parts (by weight) to one of tripolith. The water was added in the prescribed manner: sixty parts of water to 100 of tripolith, a sample of which mixture at 15 degrees centigrade (59 degrees Fahrenheit), showed on a glass tablet a period of setting of 25 minutes. Samples made in this way were tested by him as to the absolute firmness attained, 7, 28, 90, and 150 days after the mixture had been made. The Michaelis-Frühling process was used in these tests, which were made in comparison with samples of ordinary Portland cement. The result of these tests was to establish the fact that tripolith hardens in the air in the same manner as cement, though a less proportion of absolute strength is arrived at. In water, however, it was found that the cement samples alone increased in resisting power, while the tripolith samples, which had hardened in the air and were afterward placed in water, became soft, and on being touched crumbled to pieces.

Experiments made with one part of tripolith and three parts of sand (calculated by weight and in accordance with the description we have given), after the addition of the requisite quantity of water, resulted a follows:

After hardening in the air for days.	Breaking weight in lb. per square inch, cross-section.
7	76·80
28	109·51
90	123·73
150	98·13

Thus the relative maximum strength is said to be only one-third that of good Portland cement, and this strength had already commenced to diminish after 150 days. At the Patent Exhibition at Frankfurt, there was a garden temple constructed of this material. Toward the close of the exhibition, it is remarked, this structure manifested signs of external deterioration, having crumbled away in some places, and having also partially acquired a dark color on account of a portion of the gypsum having been washed away by rain, and the coal dust having remained behind. Thus the final conclusion is arrived at, that tripolith is a substance which for certain purposes can be advantageously used as a substitute for plaster. Among these is named the production of statues, busts, and similar works, for which the bluish-gray shade of the material is not unsuitable; while its adaptability to being colored is also a useful feature in connection with this branch of its employment. From the foregoing details it is, however, argued that its use as a building material must be limited to those instances where it is not likely to be exposed to the influences of the weather or of water. It is also urged that the cheapness of both plaster and cement at the present time renders a substitute for them all the less necessary.

The manufacture of artificial sandstone is described by the *Baugewerks-Zeitung* in a recent issue. The chief ingredients of the Schönweid article are said to be cleanly-washed quartz gravel, fine sand, Rüdersdorf lime, and Portland cement, mixed in large drums, heated by the admission of steam, and colored by the admixture of metallic dyes. The plastic mass thus formed is moulded into the requisite shape, and is firmly pressed down by ramming, or by hydraulic force. It depends upon the technical direction of the work, on the good and pure quality of the gravel and sand, on the fineness and freedom from impurities of the lime and cement, and more particularly on the careful mixing—for the stones to leave the moulds without difficulty, and subsequently to resist the influences of heat and moisture to which they may be exposed.

It is, however, only possible to employ artificial sandstone for ornamental purposes, when any figure or device is repeated sufficiently often to allow of the preparation of a special mould. The extra labor of the chisel would bring the artificial substance up to about the price of the article it is intended to replace. The cost of the artificial stone in the rough mass is counted as being 60s. to 70s. per cubic meter (35·317 cubic feet). The average cost per square meter (10·76 square feet) of the façades of buildings in Berlin (openings being included in measurement) varies from 11s. to 50s. in the instances recorded.

Artificial sandstone can also be used for the ornamental parts of building work, where the main body of the structure is of the natural material.

THE CHEMICAL ACTION OF LIGHT.

By DR. J. M. EDER.

Dissociation and Decomposition caused by Light.—An aqueous solution of hydrogen peroxide decomposes in the sunlight (Downes and Blunt). Chlorine water is decomposed in the light with evolution of oxygen and formation of hydrocholoric acid, but in the dark this decomposition will not take place even at a temperature of 100° (Berthollet, Gay-Lussac, and Thénard); it occurs more rapidly under the action of the more refrangible rays (Davy), and under white than under yellow glass (Torsewicz). The decomposition depends on the intensity of the light and on the temperature, but when once set up it continues also in the dark, though less actively (De Saussure and Draper); heat promotes the action, but does not start it. According to Millon, hypochlorous acid is also formed during this decomposition, and it has been proposed to use chlorine water for actinometric purposes. Bromine water behaves in a similar way, though it is not so sensitive to light as chlorine water (Eder). Iodine water undergoes no chemical change (H. W. Vogel), though the alcoholic tincture of iodine is decomposed by light.

Concentrated nitric acid turns red in the light, oxygen being given off, and hyponitric acid formed (Scheele and Berthollet); this takes place most rapidly under white, blue, and violet, but not under red glass (Seebeck). The same change is brought about by raising the temperature (Gay-Lussac and Thénard). Gaseous hydriodic acid kept in absolute darkness, and preserved from contact with the air, undergoes no change, but is decomposed in the sunlight; in this reaction the blue rays have the greatest energy. Aqueous solutions of hydriodic acid, not exposed to the air, can be kept in the sun without decomposing; but if the air be admitted they rapidly undergo oxidation even in the dark (Lemoine). If potassium iodide, cadmium iodide, and lithium iodide, are dissolved in dilute acids and exposed to the light, the iodine will be set free, but in different proportions, depending on the kind of iodide and acid employed; with hydrochloric and sulphuric acid, this photo-chemical reaction is much more energetic than with the organic acids. The decomposition takes place more rapidly under blue than under red glass (Leeds), and advantage has been taken of this phenomenon as the principle for the construction of a photometer. Iodine is separated in the light from a solution of potassium iodide in the presence of oxygen, and carbonic acid or sugar in the solution promotes the reaction; iodide of potassium paper and ozonometer paper behave in the same way. Crystallized iodide of ammonium, exposed to the air, turns yellow, especially in blue or violet light, less rapidly in yellow light (Eder); solid potassium iodide is in the dry state unaltered by the action of light (Vogel).

Hypochlorous acid gas in the sunlight splits up into chlorine and oxygen (Balard); dry gaseous chlorous acid into perchloric acid, chlorine, and oxygen; hypochloric acid behaves in the same way (Millon). Chloride of lime is decomposed in the light more quickly than in the dark, with evolution of oxygen. (Döbereiner and Schweinsberg). Phosphureted hydrogen is decomposed in the sun with separation of phosphorus (A. Vogel), and loses its power of spontaneous inflammability as the liquid hydride contained in it is decomposed (Thénard). Sulphide of phosphorus becomes cloudy in the sunlight (Böttiger). Bisulphide of carbon turns a dark color when exposed to the sun, and a brown precipitate is thrown down.

The chromates by themselves resist any influence of light, but in the presence of organic bodies the light produces rapid reduction. This is especially the case with the bichromates of potassium and ammonium on paper (Ponton, 1839), linen, etc., and in the case of the same salts mixed with gelatine, albumen, gum-arabic, dextrin, cane-sugar, grape-sugar, glycerine, casein, alcohol, etc. Such mixtures turn brown when exposed to the light, chromic oxide (E. Kopp), and finally pure chromium tri-oxide (Eder) being formed; and they are more sensitive to light in the dry than in the wet state. Fox Talbot discovered that a mixture of glue with a chromate not only changes color owing to the action of light, but that it also loses its solubility in hot water, and its property of swelling up in cold water: gum and albumen became insoluble in cold water; and sugar less soluble (Poitevin). A mixture of glycerine and potassium bichromate turns green and thickens (Schnauss), while gum, dextrin, and sugar become less hygroscopic. Gelatine with potassium chromate is from twenty to fifty times less sensitive than with the bichromate, but ammonium chromate is equally sensitive as ammonium bichromate; free chromic acid renders glue insoluble even in the dark. Chromated gelatine which has been rendered insoluble by the action of light consists of a combination of chromic oxide with unaltered gelatine and some admixture of formic acid; gum, after being exposed to the light, forms arabate, or more probably metarabate, of chromium (Eder).

The vanadates of the alkaline metals, when in contact with organic substances and exposed to the light, turn green or blue, and if the substance be gelatine, it also becomes insoluble in water. According to Phipson molybdic acid dissolved in dilute sulphuric acid turns blue in the sunlight, but recovers its color in the dark; but Eder maintains that this change only takes place in the presence of organic substances.

Ferric chloride in contact with organic substances, and exposed to the light, is reduced to ferrous chloride; this occurs with the alcoholic or etheric solution of salt, and more especially under white and blue glass. On paper, or mixed with tartaric acid, glycerine, alloxantin, or oxalic acid, the salt behaves in the same way; Eder has shown that while the reduction of a solution of ferric chloride mixed with oxalic acid is =100, that of one with citric acid is = 19, and with tartaric acid = 25. Mixtures of gelatine, ferric chloride, and tartaric acid are insoluble in the dark, and only become soluble by exposure to the light. Ferric oxalate dissolved in water, and acted on by light, is at once converted into ferrous oxalate and carbonic acid (Döbereiner, Suckow, and Reynolds), and in producing this change the indigo blue rays of the spectrum are most active. The ferri-potassic, ferri-sodic, and ferri-ammonic oxalates undergo change under the influence of light, both in the solid state and in aqueous solution (Bussy); if the air is excluded in this reaction, ferro-potassic oxalate and carbonic acid are formed; if the air is admitted, also basic ferric oxalate (Eder and Valenta). Herschel and Draper found that ferri-citrate and its double salts are very sensitive to light, and Herschel and Schoras have found the same with the tartrate; the blue and violet rays act most energetically with these salts of iron. Sulphocyanide of iron, either in an aqueous, an alcoholic, or an etheric solution, pales under the influence of the green-blue rays, but regains its red color in the dark (Grotthus).

DIGESTIBILITY OF COFFEE AND SUGAR.

M. LEVED, in *La Médecin Practicien*, gives the results of some experimental investigations made to determine the degree of digestibility of coffee and sugar. To a dog which had eaten 210 grammes of meat he administered 30 grammes of coffee in 15 grammes of water. After three hours he killed the dog, and found the mucous membrane of the stomach pale, discolored, and profoundly anæmic. The vessels of the internal superficies, like those of the periphery, were contracted; 145 grammes of the meat remained undigested; the coffee then had retarded the stomach digestion. The abuse of coffee produces dyspepsia; the English and Hollanders, who take coffee and tea in large quantities, are frequently dyspeptic. Coffee elevates the cerebral functions; it has a pleasant and useful general effect, but the local effect is *generally* bad. M. Leved does not agree with physicians and medical chemists, who think that sugar is hurtful to dyspeptics; citing the case of one of his friends, a dyspeptic for two years, who did not take sugar, and was afraid of it, but he commenced taking 120 grammes daily without the slightest bad effect. Having given a dog 80 grammes of sugar after he had eaten 200 grammes of meat, he killed him after six hours, and found no meat in the stomach. The mucous membrane was red and widely congested. The hyperæmia of the liver was marked. After killing a dog which had eaten 200 grammes of meat and *no* sugar, he found 90 or 100 grammes still undigested. Sugar favors the secretion of gastric juice. Sugared coffee is unfavorable to it.—*La Independencia Medica.—Va. Med. Monthly.*

THE RELATION OF FOOD TO MUSCULAR WORK.

By DR. W. B. CARPENTER, F.R.S.

THAT "evil which men do lives after them," is often exemplified by the continued prevalence of scientific doctrines accredited by the authority of great names, long after their fallacy has been demonstrated by the subsequent researches of other inquirers to the satisfaction of all competent judges. For, if these demonstrations be not presented to the world under the sanction of a like authority, the old errors are continually reproduced by popular expositors, and unquestioningly accepted by ordinary readers.

Having met with a notable instance of this kind not long ago, in the reproduction, as an accepted physiological verity, of the doctrine of Liebig as to the direct dependence of muscular energy on the expenditure of nitrogenous food, I think that a journal which aims to communicate positive "knowledge" to its readers may be the appropriate medium for a brief statement of what are now accepted by all scientific physiologists as the facts of the case.

It is no derogation to the well-established fame of Liebig as one of the greatest chemists of his day,* to affirm that when he passed out of his own domain into that of biology, he made many and flagrant mistakes. Looking back after an interval of nearly forty years at his "Organic Chemisty in its Relations to Physiology and Pathology," I am really astonished at the reckless audacity of some of his assertions; as, for instance (1st edit. 1842, p. 219), that "we know with certainty that the nerves are the conductors of mechanical effects, and that by means of them motion is propagated in all directions;" and that "the heart and intestines do not generate the moving power in themselves, but receive it from other quarters." He might just as well have said that "we know with certainty that when a charge of gunpowder or dynamite is exploded by an electric spark, it is the conducting wire that supplies the energy which rends asunder the rock." For nothing was even then more certain, than that the heart, intestines, and all other muscles furnish, in virtue of their own contractility, the power (or, as it would now be called, the "potential energy") which produces their mechanical effects, this being simply called into action by the nervous stimulus.

Another most noteworthy example presents itself in Liebig's denunciation of the "germ doctrine" of fermentation and contagion, which was then being built up on the basis supplied by the microscopic discoveries of Cagniard de la Tour on the fungoid nature of yeast, and of Audouin and Milne-Edwards on the like character of the Muscardine-disease of silkworms. "A theory," he says (3d edit. 1846, p. 212), "of the cause of fermentation and putrefaction, which is utterly fallacious in its fundamental principles, has hitherto furnished the chief support of the parasitic theory of contagion. The advocates of this theory regard putrefaction as a decomposition of organic beings caused by infusoria and fungi, and consider every putrefying body as a breeding place for infusoria or a nursery for fungi; and where organic bodies putrefy over a large surface, the whole atmosphere, according to this view, must be filled with the germs of these infusoria and fungi. The germs of these organized beings are, in this theory, the germs of disease or of the causes of disease." Yet it is this very doctrine, the complete establishment of which by the admirable researches of Pasteur, and of those who have followed in the line of inquiry which he so clearly marked out, has not only given the true interpretation of the phenomena of fermentation, but in its application to pathology is now serving as the basis for "preventive" medicine and "antiseptic" surgery. And I feel sure that Liebig himself, had he lived into the present era, would have been quite ready to admit its truth; for he was the last man to persist in views no longer tenable, merely because he had himself advanced them. "There is no harm in a man's making mistakes," he used to say, "but great harm in his *making none*, for he is sure not to have worked." And Professor Hofmann records having been exhorted by Liebig "not to keep in your house from night till morning an error you have become cognizant of."

Now Liebig's chemical division of food materials into plastic, or "tissue forming" and respiratory, or "heat producing," was unquestionably an immense advance; and the basis of it is still universally recognized as sound. I can myself remember the time when it was a question whether the nitrogenous components of the blood, and the tissues formed at their expense, can be built up in the animal body, with the aid of atmospheric nitrogen, out of starch, sugar, fat, and other non-nitrogenous hydrocarbons. Chemistry had not then shown the almost exact conformity of many vegetable compounds to the albumen which was regarded as the fundamental constituent of animal food; and while it was by Mulder that the doctrine of the *protein*-compounds was worked out, which, with some modifications, is now generally accepted, it was by Liebig that the impossibility of supposing that animals can form their tissues out of anything else than the "proteids" originally generated by plants, was first definitely insisted on. He was not aware, however, that the formation of "protoplasm" requires *fat* as well as proteids; and that thus fat is to some extent a tissue food. But he was unquestionably right in affirming that animal tissues cannot be manufactured out of *saccharine* compounds (as starch and sugar), unless these have been previously changed into fat—a change whose possibility he went far to prove—and then only in the same measure as fat itself. And he quite correctly assigned as the ultimate destination of the great bulk of the non-nitrogenous components of food, the being (so to speak) "burned" within the body, by combination with oxygen taken in through the lungs; their hydrocarbons being exhaled by these organs in the form of water and carbonic acid. But he assumed that the only purpose served by this oxidation was the production of *heat;* affirming that all the *mechanical force* exerted by the animal body is the product of a transformation of *living* muscular fiber into *dead*, the "vital force" which was possessed by the living tissue being "expended in the shape of motion." The oxidation of the dead material he seems to have regarded as only a consequence of its loss of power to resist chemical agencies, and as a means of its removal—serving, at the same time, as an additional source of heat. And rightly judging that this chemical metamorphosis should show itself by the increased excretion of urea in the urine (the kidneys furnishing the channel through which most of the nitrogenous "waste" is carried out of the body), he appealed, in support of his doctrine, to what he supposed to be the fact of such increase, and its proportion to the amount of work done.

Notwithstanding the general acceptance of Liebig's doctrine among the physiologists of that time, there were those who saw that it was attended with considerable difficulties, notably as regards the amount of work done by man and animals upon a very small allowance of nitrogenous food. It was well known, for instance, that Bengalee laborers, (who, for their size, are very fair workers*) live all but exclusively on rice, which consists almost entirely of starch; a pound of this with a little ghee (butter), or a small bit of fish, constituting their ordinary diet. And it appeared from the carefully conducted experiments of Mr. Joule, of Manchester, that the quantity of work done by a grass or hay fed ox (taking into account that done by its heart *within* its body, as well as that done *outside* its body) was more than could be accounted for by the metamorphosis of the nitrogenous constituents of its food.

Mr. Joule was at that time engaged upon an inquiry into the mechanical equivalent of heat, which led him to suspect that the combustive oxidation of the non-nitrogenous constituents of food might be a source of *mechanical power*, as well as of heat. But this doctrine was first definitely stated and shown to be one expression of the great general fact (or law) now known as the Conservation of Energy in the "epoch making" treatise published in 1845, by Mayer; who urged (1), that the chemical force contained in the ingested food, and in the inhaled oxygen, is the source of the motion and heat, which are the two products of animal life; and (2), that the production of these forces varies in amount with the chemical changes to which it is due. The animal body, he maintained, is comparable, in these respects, to a steam engine, in which work is being done, and heat produced, by the combustion of fuel; and he calculated that the quantity of carbon burnt off by the body in a day (as measured by the amount of carbonic acid given off in the expired air) is far more than sufficient for the whole day's work—about four-fifths of it being used in the production of heat, while the remaining fifth suffices for the production of the muscular force ordinarily exerted within and without the body. He affirmed that "the muscle is the instrument by which chemical change is transformed into mechanical effect, not the material which is itself transformed;" and he regarded the blood stream that flows through the capillaries of the muscle, as bringing both the fuel and the oxygen needed to burn it. With the provision that marks true genius, Mayer asserted that as soon as experimental methods should become sufficiently perfect to render it possible to determine with precision the amount of chemical change, either in the whole animal body or in a single muscle, during a given period, and to measure the production of heat and the work done during the same period, the result would show a definite correlation between them.

This (as will be shown hereafter) has been completely verified by subsequent research; the only point in which Mayer's doctrine has been found to need correction, being one of secondary importance.

It has been shown that while Liebig regarded the production of muscular energy as an expenditure of the "vital force" of the muscle substance itself—involving its death and chemical transformation, and requiring *nitrogenous* or tissue food for its regeneration—Mayer attributed the production of that energy to the oxidation of a portion of the *non-nitrogenous* or respiratory food, regarding the muscular apparatus as a mere instrument by which that oxidation is made to produce motion in place of heat.

I shall now give a general account of the experimental inquiries by which Liebig's doctrine has been disproved, and that of Mayer established. These have reference to the relation of the *amount of work* done by the body as a whole: (1) to the relative consumption of the nitrogenous and the non-nitrogenous components of the food; (2) to the amount of carbolic acid exhaled; and (3) to the amount of urea passed off; while (4) another set of experiments on isolated muscles has demonstrated the dependence of the production of energy upon a change in the substance of the muscle itself, rather than (as Mayer supposed) in the blood passing through it.

1. If a man be carefully "dieted" for a time long enough to determine the amount of *nitrogenous* aliment adequate to repair the ordinary daily "waste" of his tissues, and the amount of *non-nitrogenous* aliment needed to maintain the heat of his body at its normal standard and keep him in healthful exercise, so that his weight remains the same at the end of the experiment as at the beginning—and he is then set to make a great addition to his daily exercise in the shape of walking, pumping, turning a machine, or the like—it is found that his body can be kept up to this work by an increase in the supply of *non-nitrogenous* aliment, with such a small addition to the nitrogenous as may suffice to make good the loss produced by the increased "wear and tear" of the machine itself.

2. All observations concur in showing an *immediate* increase in the exhalation of carbonic acid, capable of being determined with rigorous exactness, when the body, previously at rest, is put into motion. The late Dr. Edward Smith made himself the subject of a long-continued and diversified series of researches upon this point, by the use of a portable gas meter, through which he could breathe when walking or working at a tread wheel, as well as when standing still, sitting, or lying; and he found not only that when continually "getting up stairs" on the tread-wheel, he exhaled more carbonic acid than when walking; that when walking fast up hill he exhaled more than when walking slowly on level ground; and that in the latter case he exhaled more than when standing still; but that he exhaled more when standing than when sitting, and more when sitting upright (without support to the back) than when lying so fully supported as not to put forth any muscular effort. Further, he found that when in walking, he carried a weight even of a few pounds, the exhalation of carbonic acid was sensibly augmented; the increase being still greater when the weight had to be *raised* (as in walking up hill), as well as transported. These results have been confirmed by numerous other experimenters. They are in remarkable harmony with those long previously obtained by Mr. Newport, upon the relative amounts of carbonic acid exhaled by a bee at rest and a bee "buzzing" under a glass.

3. The employment of more exact methods for the quantitative determination of urea than that used by Liebig, has shown that he was altogether wrong in asserting that a corresponding increase is produced by muscular exertion in the quantity of that substance eliminated by the kidneys. An experiment which has now become "classical" was performed upon themselves by Professors Fick and Weslicenus in 1866, namely, the determination of the respective quantities of urea eliminated by each of them for twelve hours *before*, or eight hours *during*, and for six hours *after* the ascent of the Faulhorn, whose height is about 6,500 feet. They took no nitrogenous food either for seventeen hours before the ascent, during the eight hours of the ascent, or for six hours after the ascent; but then took a good ordinary meal. The mean of the two determinations (between which there was a very close correspondence) gave for the twelve hours before the ascent 0·62 gramme, being at the rate of 0·052 gramme per hour; for the eight hours of the ascent 0·40 gramme, or at the rate of 0·05 gramme per hour; and the same amount for the six hours following the ascent, being at the rate of 0·066 gramme per hour; while for the twelve hours after the subsequent meal, the mean amount was 0·48 gramme, or at the rate of 0·04 gramme per hour. There was thus a positive reduction in the amount of urea eliminated, which was probably attributable to the temporary abstinence from nitrogenous aliment; since the results of subsequent observations carried on for a much longer period upon men going through severe exertion upon an ordinary diet (as those made by Dr. Austin Flint, of New York, upon Weston, the pedestrian, during a five days' walk of 310 miles), show a slight total increase in the elimination, which is fairly attributable to the general "wear and tear" produced by the excessive strain put upon the machine. There is, then, no foundation whatever for the assumption of Liebig that every exertion of muscular energy involves the death and disintegration of an equivalent amount of muscle substance.

4. It now appears certain that the chemical change which is the source of muscular energy occurs in the muscle itself, not in the stream of blood that courses through it. For the muscular tissue nourishes itself at the expense, not merely of the *protoplasmic* constituents of the food brought to it by the blood-current, but also of the *saccharine;* and, in addition, takes in oxygen which the red corpuscles of arterial blood bring to it from the lungs. A sort of explosive mixture is thus formed which is "fired" (so to speak) by the nerve discharge; a certain quantity of the saccharoid being thus caused to unite with the oxygen contained in the tissue, producing at the same time the *heat* which raises the temperature of the muscle, and the *motor force* exerted in its contraction; while the carbonic acid, which is the product of this oxidation, together with the residual water,* is conveyed away in the return current of venous blood. But that this "explosion" (the term is only used figuratively, to indicate the *suddenness* of the chemical change, and its excitement by nerve discharge) does not involve the destruction of the tissue, is evident from the consideration stated by Mayer, that the amount of work done by the heart (which is capable of very exact measurement) would require, if it involved the disintegration of the muscular tissue, a renewal of it at the rate of a *heart per week*. But muscle substance constitutes no exception to the general rule that every tissue in the body has a term of life of its own; as we see in the rapid waste it undergoes when entirely thrown out of use. And it is the need of renovation thence arising, that gives rise to a demand for *nitrogenous* aliment; this being used to keep the machine, so to speak, in working order, not to serve as its fuel.

Again, it was formerly supposed by physiologists that the conversion of arterial into venous blood (which chiefly consists in the replacement of a portion of its oxygen by carbonic acid) takes place in the capillary network of the system generally; but we now know that it goes on at very diverse rates in different parts, and varies in the same part according to its functional activity. Now, this variation especially shows itself in the blood that passes through the muscular substance; for when a muscle is at rest, the blood returned by its veins retains almost completely the character of that brought by its arteries; while, if the muscle be thrown into contraction by nervous or electric stimulation, the returning blood at once assumes the ordinary venous character—thus showing the dependence of its conversion upon the action of the muscle. We get a corresponding result by experimenting on a separated muscle; that of a cold-blooded animal being most suitable, as longest retaining its vitality when removed from the body. If the muscle of a frog, placed in a closed chamber exhausted of all save watery vapor, be repeatedly called into contraction by electric stimulation, the chamber is found, after a time, to contain carbonic acid in a quantity proportionate to the number of such contractions, showing that some component of the muscle substance has undergone oxidation; and since no other product of chemical action is discoverable, it may fairly be concluded that what has been given off from the muscle is part of the saccharoid matter which chemical analysis proves to have been previously stored up in its substance. The union of the saccharoid with the oxygen, also stored up in the muscle, produces an amount of energy that can be determined (in the form of units of heat) by the quantity of carbonic acid found in the vessel. This energy, however, may express itself in motion as well as in heat; and the amounts of both may be determined with considerable precision—the former as units of *work* done, the latter as units of *heat* by which the temperature of the muscle is raised. Now, if the units of work be turned into their equivalent units of heat, and the two amounts be added together, they give a total so closely accordant with that deduced from the the quantity of carbonic acid produced, as to afford the most striking confirmation of Mayer's prediction, "Convert into heat," he said, "the mechanical product yielded by an animal in a given time, add thereto the heat directly produced in the body during the same period, and you will have the total quantity of heat† which corresponds to the chemical processes."

To sum up: the *mechanical working* of the body of a living animal is as directly dependent as its *heating* upon the oxidation of the hydrocarbons of its food; and these may be most economically supplied by non-nitrogenous substances. On the other hand, the mechanism can only be kept in working order by the continual renovation of its substance (its very existence as a living whole involving the continual death and decay of its component parts); and for this reno-

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* See "The Life Work of Liebig," by Prof. Hofmann, the "Faraday Lecturer" for 1875.

* I have been informed by an engineer who superintended the construction of part of the Bengal system of railways, that the average quantity of earthwork done by a native laborer on the above diet is about two-thirds that of a highly fed English "navvy."

* The saccharoids may be regarded as consisting of carbon *plus* the components of water, so that the amount of energy (whether manifested in heat or in work) produced by their oxidation, is proportional simply to the quantity of carbonic acid generated. In oleaginous compounds, on the other hand, the number of oxygen atoms is not nearly equal to that of the hydrogen atoms; so that their oxidation generates not only carbonic acid, but also water. It is pretty certain that this metamorphosis, like that of saccharoid, takes place in the substance of the muscle, since it must be the chief source of energy in carnivorous animals whose food contains no saccharoid. But we have no means of distinguishing the water thus generated from that which is otherwise present.

† It would appear from the experiments of Fick upon frogs' muscles, that of the whole energy generated by the oxidation process, about five-sevenths show themselves as heat, while the other two-sevenths do the mechanical work. In the bodies of man and other warm blooded animals, however, the proportion of heat to work is ordinarily much larger; the former constituting about five-sixths of the total energy generated by the oxidation of the food, while the latter is only about one-sixth. Still, considered simply as a contrivance for doing mechanical work, the human body compares favorably with a steam engine; the very best form of that machine only exerting about one-eighth of the power which is generated by the combustion of the coal it consumes, the remaining seven-eighths being wasted.

vation a supply of *proteids* is essential, with a certain admixture of *fat* to serve as material for protoplasm.

I have thought it worth while to enter somewhat fully into the particulars of this inquiry, since it affords an excellent example of the truly scientific methods on which physiology is now being studied and of the value of the results that are being obtained by their use. It is by such methods alone that the physical and chemical actions taking place within the living body can be so determined as to give to physiology that place among the exact sciences which its earlier cultivators could scarcely venture to hope it would ever attain.—*Knowledge.*

FRIEDRICH MOHR'S THEORY OF THE FORMATION OF COAL FROM MARINE ALGÆ.

To the Editor of the Scientific American:

In the last issue of your excellent journal I find a short paragraph on "A New Theory of the Formation of Coal," in which you state that Prof. Reinsch has found coal to be derived from a lower order of protoplasm. Mention is also made of the theory which attributes the formation of coal to the depositions of algæ. In connection with this theory you name Dr. Merck, of Bochum, as its author. This is an error—which may perhaps be referable to a not improbable typographical error in one of the exchanges from which your item was gleaned.

The ingenious theory that coal has been and is forming at the present day from depositions of algæ has first been advanced by the late Prof. Dr. Mohr, of Bonn, in whose unique work, "Geschichte der Erde," it was for the first time expounded. Since the first edition of this book was printed in 1866, it will be seen at once that the priority in regard to the algæ theory belongs undoubtedly to him. Reinsch has only confirmed by his microscopical researches what the great savant in Bonn had previously established on purely logical deductions, fortified by certain chemical facts which go far to corroborate this theory, of which professional geologists do not want to take any notice.

The absence of any well-defined structure in coal has been a source of perplexity to the geologist ever since this matter has been studied, and various theories—especially the peat theory, have been advanced to account for it. But there was never any unanimity in this respect among geologists, and most of them have for convenience' sake relied on a swamp vegetation, with a sprinkling of gigantic calamites and equisetaceæ for the purpose of understanding the matter. It is, however, a conspicuous fact that the number of trees (stigmaria, sigillaria, etc.) found *in coal, not in the strata above or below*, is utterly insignificent compared to the bulk of the immense beds worked up to the present day. They have been counted up to 1846, and in that year amounted (in Europe and America), all told, to 277 stumps of trees, no more! Since then no approximate figures are obtainable.

From this scarcity of trees on the one hand and from the fact that coal itself is occasionally met with in strata of one inch and even less thickness, Mohr draws the inference that these tree stumps are accidental, and that the material from which coal has been formed must be marine algæ. The number of the various sea-tang and fucus plants is enormous, according to all reports. The coast of Great Britain is studded with no less than 370 species, while most of these fucus plants inhabit the Arctic as well as the temperate zone. They attain a prodigious length and size; the *Alaria* which is found in the Atlantic as well as in the Pacific Ocean has leaves 40 feet long and several feet broad, while *Macrocystis* and *Fucus giganteus* grow equally large.

On the southern hemisphere the growth of these plants is luxuriant. Mohr mentions an instance which is reported by Darwin. In the neighborhood of Terra-del-Fuego a fucus covered bank was passed which had a depth of more than 24 fathoms; since the leaves of the Fucus giganteus were buoyed on the surface everywhere this plant must have had stems very much longer than 144 feet, because these plants never grow up vertically, but slanting upward in a very acute angle. Darwin himself compares the primeval woods of the South American continent with those at the bottom of the Antarctic Sea, and does not hesitate to declare the latter to be by far the grandest. At the same time this submarine vegetation forms the habitat of an enormous number of animals, as has also been described graphically by Darwin.

These are bound to live and die with the plants. As soon as the latter have been torn from their roots they drift about in the ocean until they die and sink, the animals dying and sinking with them. The location where the deposits of algæ take place is determined by the ocean currents, in the neighborhood of their place of growth; generations after generations will thus grow, die and sink. If the region of deposit is very near to a continent or large island, the rivers will furnish deposits of land detritus during certain periods (floods), and thus the stratification of the "coal field" of the future will be effected. By degrees the currents will change and the coal beds may in future ages gradually rise until their surface is above the level of the sea.

This in short is the theory of Mohr, which is based on natural phenomena and furnishes the only explanation of the ultimate disposition of the immense submarine vegetation.

But Mohr does not content himself with this; he goes into the chemistry of coal, and takes occasion to fortify his view with formidable arguments.

The first point in question is the amount of *mineral ingredients*. As Mohr refers the latter to the accidental admixture of land detritus it is evident that coal must on an average contain much less than peat, lignite, etc. This is actually the case; for although there are exceptions to both cases in question, lignite on an average contains up to 14 per cent.; coal contains rarely more than 5 per cent.; anthracite coal as a rule much less.

The next subject is the considerable percentage of *nitrogen* in coal. Distillation of coal invariably develops ammonia, while with peat and lignite this is an extremely rare occurrence, acetic acid being nearly always the product produced by distilling the latter. It is well known that the gas factories furnish nearly all the ammonia of commerce.

This great proportion of nitrogen is referred by Mohr to the innumerable animals that lived on the sea-tang from which the coal is formed, as has been referred to above.

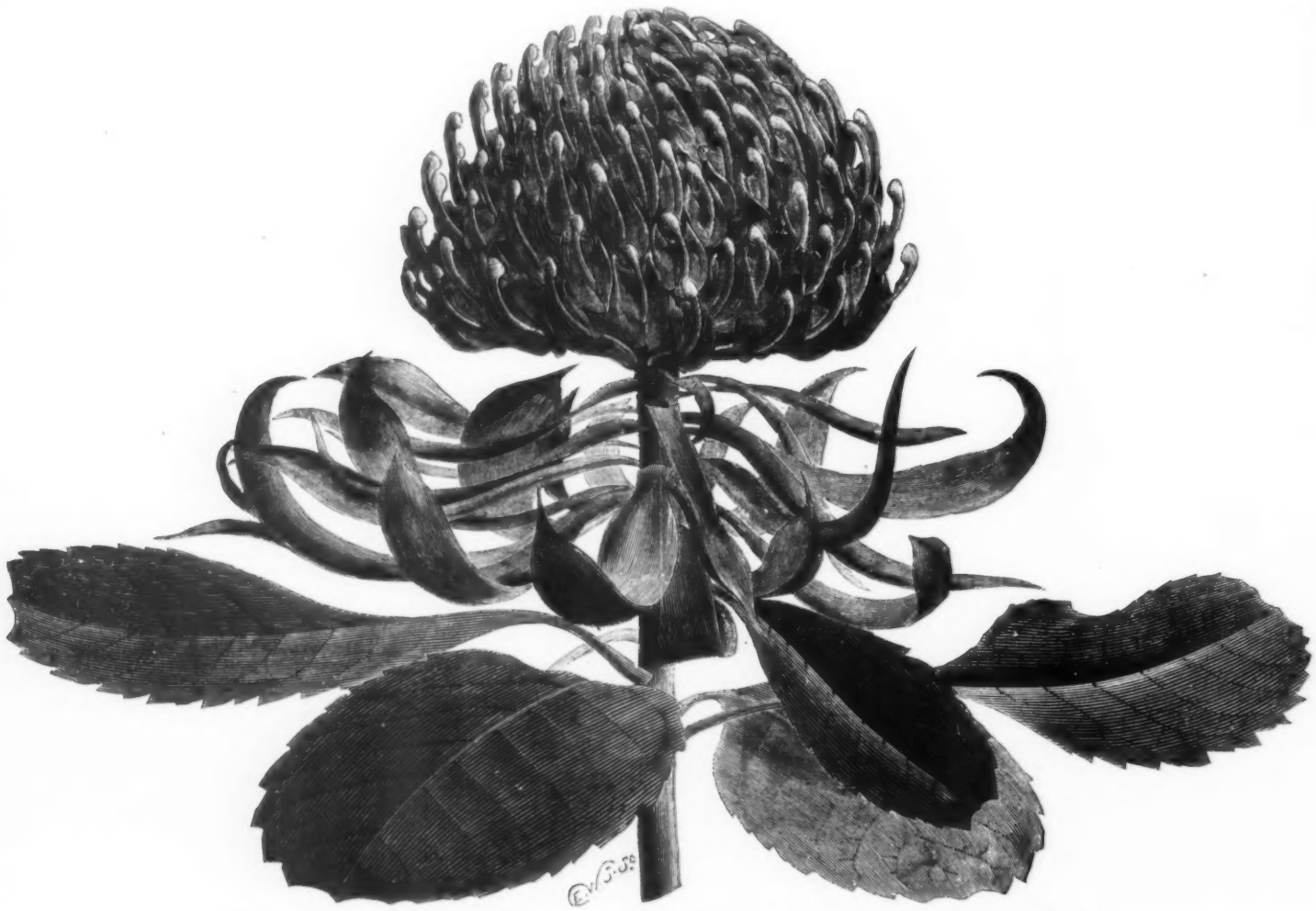
Another matter is the *specific weight* of coal, which is invariably greater than that of water (1·25–1·40) while that of peat and lignite is less; the latter will with few exceptions float, the former never. The marine plants from which coal has been formed are in themselves heavier than water, and are buoyed up only by the great number of large air-cells which they contain; therefore coal, whence the air-cells have disappeared and a uniform stratification by pressure has taken place, must of necessity be heavier than water.

The last and most important fact which I shall mention—passing several others of minor importance—is the *presence of Bromine and Iodine in coal soot*, which was proved by Mohr, and, at his request, by Prof. Landolt.

This, in short, is the "sea-tang theory of coal," as first advanced and elaborated by that greatest of geologists the late Prof. Friedrich Mohr. GEO. W. RACHEL, M.D.

TELOPEA SPECIOSISSIMA.

SIR GEO. MACLEAY recently showed through his gardener, Mr. Green, a fine flowering branch of this noble Protead. We only regret that the black and white of the engraving cannot do justice to the clear pink coral color of the flowers or the rich crimson tints of the environing bracts. The specimen produced by that skillful cultivator is not only superior to all that have been figured before, but surpasses the ordinary condition of the Waratah in its native country (New South Wales). We can but hope that Mr. Green's success may be the means of inducing others to undertake the cultivation of these noble plants with whose sumptuous grandeur our forefathers were much better acquainted than we are. Abundance of water during the growing period, dry heat during the process of maturation, and something approaching drought during the resting stage, would seem the necessary conditions of success.—*The Gardener's Chronicle.*



TELOPEA SPECIOSISSIMA: FLOWERS CORAL RED, BRACTS CRIMSON.

TRAVELS OF PLANTS.

So far as the plant world is concerned man inherited a defective world, which in many regions was a desert ill provided with useful plants. The indigenous fruits of Australia were small, and its earliest population fed on fern and other roots. The fruits of Europe before the period of the Romans were inferior apples, pears, plums, and raspberries, with blackberries, beech-mast, and hazel-nuts. The ancient Britons must have fared much like the people of Arcadia—

> "Acorn meals chief culled they from the sheds
> Of forest oaks; and in their wintry month
> The wild wood-whortle with its purple fruit
> Fed them, larger then and more amply poured,
> And many a boon beside, now long extinct,
> The fresh formed earth her hapless offspring dealt."

The existing vegetation of Europe appears to have been derived from the North by means of natural migration, or the scattering of seeds each year further afield. Wide gaps may now divide the sites of the original vegetation. There is an oak (*quercus cerris*), growing generally in Asia Minor, which is found in Europe only in a few widely separated stations, such as the Apennines, parts of Sicily, and on the banks of the Loire. The pinus excelsa is another tree without a link between its stations, which are now as wide apart as the Himalayas and the mountains of Roumelia.

The continuity of the ancient forests has been destroyed by changes in the surface. There is a shallow sea now between the forests of Scotland and those of Norway, and between the oak and beech woods of Denmark and those of our shores; and the sunken forests round our coast, especially on the coast of Norfolk, are the remains of the chain of vegetation which at one time was stretched between England and the continent. At the dawn of the present stage of creation Northern Europe appears to have been denuded of its vegetation by glaciers. Earlier floras had been already buried beneath many and many a layer; a more recent one was now destroyed or driven into alpine heights.

In consequence of such catastrophes as that of the ice period Europe became bare of plants at a time when Asia was a garden, and accordingly we may believe that long before the dawn of history plants were moving westward and southward to occupy Europe, just as population did at a later period. The origin of the most useful plants is legendary, as might have been expected. The vine, a migratory twiner which has run round the globe, climbed high in man's affections, and made surprising inroads on his pocket—has several disputed birthplaces. According to the legends, Africa owed it to Osiris, and Europe to Bacchus. The Jews claimed it for the slopes of Hebron. Its real birthplace was, perhaps, that same Persian paradise which produced the fig, peach, and apricot. The orange, which was unknown to the ancients, was not the "golden fruit" planted by the poets in the garden of the Hesperides, but a Chinese fruit, introduced into the West by the Arabians. The "golden fruit" referred to is believed to have been the citron.

These are a few of the most essential or interesting plants which several of the leading nations possessed in a period too dim to admit of its obscurity being penetrated. Barley has been traced to Tartary, and Wheat to the banks of the Indus; and here the learned have lost sight of these important cereals and have taken up their pens for discussion with such rage as detectives feel when baffled. The Greeks were by no means incurious about plants, and in hunting down the olive to its original site they came to the conclusion that it must have been created by Minerva and brought to Greece by Hercules. But for the destruction of the Alexandria Library we might know more of the origin of useful plants; we must be content to utilize such knowledge as we do possess. The crocus first sprung amid the grass on Mount Ida at the instant of an embrace between Juno and her wandering husband, greeting her there unexpectedly. As a very widespread plant it must have afterward sprung up in many other places—perhaps on similar occasions.

Having lingered rather long in the fields of conjecture let us now push on into those of history. The most useful plants were distributed by colonists and conquerors. Tyre was an emporium from which the apples which the Romans found in Britain may have been introduced by the Phœnicians, who came to Cornwall for tin, and who carried the mulberry to the western shores of the Mediterranean, and planted Carthage, a city famed for farming beyond all other places of antiquity.

After the destruction of Tyre by Alexander plants continued to be distributed chiefly by the hands of soldiers. Rice accompanied Alexander from Persia, and followed the Moors to Spain, *en route*, it may be said, for America.

Cotton has a long history, and has traveled far. Alexander the Great observed it in the Punjaub previous to its cultivation in Egypt, where Herodotus found linen cloth in universal use; but in the time of Pliny, Egypt, like India, was clad in cotton. This "tree wool," as the astonished Germans named it, found a congenial home afterward in America, whence it revisits its native country in the form of fabrics from the mills of Lancashire. Rome in her day became the rendezvous of plants, which she collected with great assiduity. Italy had been bare of native fruits; Rome made her rich in subtropical productions suited to her climate, and filled her gardens with nearly all the culinary vegetables which are now in use, including that curious cabbage, the cauliflower, which appears to have been developed by successive steps from the cliff cabbage, in the luxurious island of Cypress. A cherry tree in full fruit from Pontus entered Rome at the triumph of Lucullus. All the fruits of Persian paradises which had not been already introduced into the basin of the Mediterranean by the Greeks reached Rome direct from their native places. The fig, it will be remembered, had sheltered the wolf which suckled the founder of the city. It is a fruit which is said to have rendered Bacchus corpulent, and which reached the neighborhood of Olympus early.

The vegetable acquisitions of the Romans were distributed among her colonies. The plane reached the tomb of Diomede in Apulia from "the East," according to Pliny, and thence spread over Greece and Italy, arrived in Sicily, and was in Gaul A. D. 79, the people being taxed at that time for planting it. The cherry was in England within five years of the annexation. The box, the peach, the walnut, the vine, and the poplar followed, as did the pear, mulberry, fig, damson, and medlar. The Roman generals and governors in England were both anxious and able to surround their handsome villas with the trees and shrubs of Italy. The bay or laurel of the ancients came with other sweet-smelling plants, which the Romans held in great favor. Our common laurel is a cerasus or cherry, a native of Trebizond and the shores of the Black Sea, and was introduced from Civita Vecchia A. D. 1614, or about 1,600 years later than the nobler shrub. The old English elm is not a native, like the wych elm, and in all probability we owe it to the Romans.

It has been said that barley was introduced into Germany and Britain by Cæsar; but in that case those countries were far behind their neighbors who possessed barley as early as the Stone Age. *Ber*, the Saxon name for barley, in the root of the word beer, a beverage, and bere, a coarse kind of barley grown in Scotland. The hardier kinds of this hardy cereal have reached nearer the poles, and have ascended higher up the sides of mountains than any of the other grain-bearing grasses, succeeding wherever there is a mean temperature of 48° during ninety days of the year. In Lapland, at 66° N. lat., where it cannot be sown until June, it has just sun and time enough for ripening, and none to spare; while in England our two-rowed barley—the parent of the barley family—enjoys a career of five or six months from the day of sowing to the day of ripening, and having acquired a certain habit as to the pace at which it proceeds between seed time and harvest, it suffers a good deal in hot summers, when hurried by the effects of the unusual warmth.

The Moors succeeded the Romans as carriers of plants westward, and Spain owes them that very useful Persian forage plant, alfafa or lucern. The olive, which yields the cream and butter of Spain, had arrived previously. At the commencement of the Dark Ages, when the North enchained Southern Europe, plants ceased to travel. Afterward we hear of Charlemagne's garden on the banks of the Rhine, and a little later the monks became cultivators, and the Crusaders brought agricultural information from the East. But the circumstances of the age were against the travels of plants until the close of the Middle Ages and the epoch of Elizabeth. Then the rose beds which the wars of the rival houses had trampled under foot were replanted. As early, however, as 1453, when the Eastern Roman Empire fell, "Dutch bulbs" were first grown in Holland. The ranunculus, anemone, tulip, hyacinth, and narcissus were all originally oriental, and were first brought from Persia to the west shores of Europe in the bales of Dutch traders. Dutch gardening was afterward introduced here and Dutch bulbs brightened English parterres at Nonsuch, Hampton Court, Hatfield, and other places. There is a long list of ornamental trees and other plants which arrived here at the commencement of the age of industry after the close of the Middle Ages. Hops at length (A. D. 1523) followed barley, which in the light and bitter beer of Burton they have now almost superseded. Fulham became famous for its foreign foliage, as it is still, under the auspices of Bishop Grindal. Cecil, Bacon, Gerard, the herbalist, and Raleigh, all aided the travels of plants, and the latter, imitating Hercules, brought home some exceedingly useful seeds, or tubers, in his pocket, on returning from his travels.

The wild plants of Peru and Chili were carried by the first explorers of those countries to Spain long before they grew in England or Ireland. Potatoes were in Burgundy in 1560, and in Italy about the same time In 1584 they were at Youghal, but it was not until thirty years later that they took firm hold of the ground in Ireland on their re-introduction at Youghal by Sir Walter Raleigh. Meanwhile Gerard, the herbalist, received from Sir Francis Drake some tubers, which he planted in his garden at Holborn. In 1663 the Royal Society published rules for the cultivation of the new crop. The Dutch carried the potato to the Cape, and it passed into India in 1800, and has generally spread over the whole world, being confined in hot countries to the hills.

The potato recalls the memories of an age of travels and voyages, when Drake sailed westward with his five ships, singeing the King of Spain's beard on his passage, and reappearing to be dubbed Sir Francis after having circumnavigated the globe. The nation was at all times extremely curious as to foreign countries, and having become wealthy by means of trade and the growth of wool, it naturally welcomed traveled plants and introduced them in its gardens. In exchange for the potato and two other plants, tobacco and cinchona, America obtained from this hemisphere sugar, coffee, and the cocoa-nut.

A word or two on the sugar-cane, a plant allied to the Indian rattan, but in the estimation of schoolboys widely different in flavor—the one being bitter, and the other sweet. We pass over its early travels from its home in China, and notice only its passage into Spain with the Moors, into Madeira and Mexico with the Spaniards, into Brazil with the Portuguese, into Barbados and Jamaica with the English colonists in the seventeenth century, and into Bourbon and Mauritius with the French.

The exchange of plants between America and the Old World includes wheat and maize, whose typical climates are widely different. It is the habit of maize to commence its growth suddenly at a gallop in June. Wheat, on the contrary, prefers to advance gradually, and it breaks down with rust and mildew when forced on by an excess of sun, without a sufficient pause between seed time and harvest. Maize has been known to run its course in ninety days, and to reach the thrashing floor to the tune of 160 bushels per acre. It is not surprising, therefore, that this prolific grain should have accompanied the colonists of various nations over the whole of America from Chili to the chain of lakes. It was introduced into gardens on this side of the Atlantic within fifty years of the first voyage of Columbus. It entered the Mediterranean by way of Spain, and before the death of Queen Elizabeth and her counselors—two of whom were noted gardeners. It reached the Levant, where it became an important item in the trade of the Venetians. It afterward passed up the Danube to Hungary, and traveling eastward with the merchandise of caravans, it gradually entered the rice countries, and reached China and Japan. Maize, however, is a native of temperate zones, and rice of the tropics, consequently there are points where they part company. The latter does not find sufficient warmth in Europe north of the Alps; the former is at home in Ohio, Illinois, and the northern part of Kentucky, but in the Gulf States it finds too much heat. In the hot districts, where cotton and the sugar-cane flourish to perfection, it becomes magnificent in stem and leaf, and proportionately deficient in the ear or cob.

We will now take tea. It has not been a great traveler as a tree, but the leaf ranges wide, and frequently passes twice through the teapot in company with any other small leaves resembling it in size. The first tea was brought to England in 1666 by Lords Arlington and Ossory, who obtained it from the Dutch East India Company. Its original price was 60s. per pound. Fortune and other authorities describe the *thea bohea* and *T. viridis* (green tea) as varieties produced by the influence of age, soil, climate, and cultivation. Souchong, hyson, etc., are sorts which receive their names according to the time of picking and the age of the leaf and of the wood which bears it. Tea leaves, like grass in process of being made into hay, can only retain their green color when quickly dried without oxidation of the juices by exposure in damp weather. Artificial green tea is colored by the use of indigo, gypsum, and Prussian blue, and being slightly poisonous, it has sometimes been known to "murder sleep."

The Paraguay tea, so largely used in Brazil and neighboring countries, is a holly of restricted habitat, with properties very similar to those of tea.

The coffee tree is an indigenous evergreen in Arabia, where the berry remained locally unused till a mufti of Aden acquired a taste for the beverage produced from it in Persia. In 1554 it was sold at Constantinople, where it had a remarkable effect in emptying the mosques in favor of the cafés. The berry traveled westward in 1615 as an item in the Venetian trade. The cafés of Paris and the corresponding shops in London became fashionable at the end of the century.

To the preceding list of plants, which have been distributed by the industrious hands of man, we propose to add a few trees, placing first the date—a palm which has traveled from the confines of Asia through the Syrian and African deserts. Some of the finest plantations are those around Medina. Those of Egypt are important.

Two other equally important plants are the banana and plantain, tropical fruits which appear to be indigenous both on the Euphrates and the Orinoco. A patch of bananas yields four or five times as much food as the same breadth of potatoes, and the tree grows from a sucker, bears fruit in eight months, and sprouts and fruits again in three months. It is, therefore, a convenient tree for the tropics, and has been dispersed over them from the earliest ages. It will be remembered that the bread fruit of the Pacific—a tree producing fruit the size of penny loaves, yellow, sweet, and pleasant to the taste—was once set up in opposition to the banana. The excitement on the subject culminated in London, in the idea of a crop of unadulterated bread growing ready baked in a large spreading tree of the Friendly Islands. George III. was accordingly petitioned on the subject, and the Bounty was sent out to Otaheite under the command of Lieutenant Bligh, for the purpose of securing some specimens of the important tree. The Bounty reached her destination in 1788, and shipped 1,500 young trees, which were destroyed during the mutiny. A few years later Admiral Bligh received a similar commission, and succeeded in conveying the bread fruit to the West Indies, where the colonists soon discovered it to be inferior as food to the *fooi-fooi* of the plantain or banana, while the tree itself is of slow growth.

Other food trees of the tropics are the cacao, which cannot wander beyond the regions of great atmospheric heat and moisture; and the dourian, the largest of tree fruits which Mr. Wallace enjoyed in the Malayan archipelago. For the sake of naming the second largest tree fruit, we mention the Brazil-nut, whose woody fruit holds sometimes a quart of those angular and oily nuts. Circumstances prevent these trees from traveling far, but there are others to be briefly noticed.

The aspen trembles all through Europe. It may have commenced its curious habit in the Caucasian range, where it is still a prominent tree, but historically it has always been dispersed over Turkey and Russia as far as the Frozen Ocean, and there is nowhere such a trembling of aspen leaves as in the woods around Moscow, where innumerable seedlings sprang up after the conflagration of 1813. The aspen is found in the bogs of Denmark at all depths, while the alder, birch, and hazel do not occur below the oak level. Like the Scotch fir, therefore, it is one of the primeval trees of Europe. It is also a native of the woods of Invercauld, near Braemar, where it ascends to a height of 1,600 feet. It travels into Sutherlandshire, loves moist situations and woods, overhanging the Highland lochs. The margin of Loch Katrine and the islet of the "Lady of the Lake" are its favorite sites.

In the Highlands, on the banks of the Dee and the Spay, in the pass of Killiecrankie, and everywhere in England, what tree is so bewitching in its beauty as the birch of Russian pleasure-grounds and of Siberian and Icelandic wastes? On the Apennines the birch begins to grow at about 5,000 feet above the level of the sea, in Lapland it ceases at a line 800 feet above the fir, and 2,000 feet below perpetual snow. The birch is the superlative tree as regards the extent of ground it covers, in Northern Europe, and in the variety of purposes to which it is converted in Lapland, where the natives sit in birchen huts on birchen chairs wearing birchen boots and breeches, with caps and capes of the same material, warming themselves by fires of birchwood charcoal, reading books bound in birch, and eating herrings from a birchen platter, pickled in a birchen cask. Their baskets, boats, harness, and utensils are all of birch—in short, from cradle to coffin the birch forms the peculiar environment of the Laplander.

That fastigiate tree, the Lombardy poplar, has been traced from Persia, where it abounds, and from the Himalayas, to the banks of the Po, and thence to the margin of our English streams. About a hundred years ago Lord Rochford imported from Turin the first cuttings of the Lombardy poplar, which introduced here the novelty of a pole clothed with foliage.

The cedar of Lebanon is a modern tree in Europe. The oldest are, or were, at Chelsea, the tallest at Strathfieldsaye, the largest at Sion House. Lebanon is a wet mountain whose frost and snow equals that of Scotland; consequently the cedar of Lebanon is adapted to the English climate and affects damp situations such as the banks of the Thames. It likes to dip its roots in running water for the purpose of absorption in dry weather. On dry soils it will be found a dwarf.

The introduction of the cedar of Lebanon into France was an effort of most interesting devotion on the part of Bernard de Jussieu, who brought it from the Holy Land in 1737, and kept it alive on the voyage by sharing with it the very small quantity of water which he received during a prolonged passage. In the absence of a flower-pot Jussieu is said to have planted the cedar in his hat, and by giving it a moiety of his daily glass of water he succeeded in keeping it alive, and afterward had the satisfaction of planting it in the Jardin des Plantes at Paris. In 1837, at the age of 100 years, it was cut down, having attained a height of 80 feet.

The elm, a wayside tree in Germany, a vine-peg in France, and an ornament of several avenues in Madrid, is a puzzling tree to botanists, the genus being too mixed in character to reproduce itself true from seed. The wych elm is our only undisputed native, ripening its seed in our climate—the surest test of a native tree—and extending from the coast villages in Sussex to the haughs of the Teviot and Tweed, and even to the Highlands. All the varieties of the British elms may be referred to this Ulmus montana, and to the old English elms—Ulmus campestris—which has smaller leaves, throws up numerous suckers—not a habit of the wych elm—and sometimes displays a trunk of 90 feet long and 15 feet girth. This is a constant tree of avenues and parks in the southern and midland counties and of hedgerows in the valleys of the Thames and Severn. It is spread over Southern Europe, Western Asia, and Northern Africa, and it has been naturalized in England, where it rarely ripens its seeds, of which, indeed, only a portion ripens in France and Germany. The English elm was rarely found in Scotland before the Union, and only on sites where it was known to have been introduced. It has been distributed over Ireland in modern times. Evelyn spoke of it as being rarely seen north of Stamford, and as having been imported from Italy by our great benefactors the Romans. Even Philip II. admired the stately form of our tree of lights and shadows, whose open foliage admits the light and produces "the checkered shade," which is the charm of woods. He had sat, perhaps, though not too often, with Mary—

"Under the shady roof
Of branching elm, star proof,"

and on his return to a more congenial country he transported to the Escurial some English elms.

Space will not allow us to add to this short selection of traveling plants, and we have therefore omitted the Conifers, which have arrived from the East and West in this age of easy transit in numbers too great for enumeration. The same remark applies to the plants introduced by private firms, and to those collected by Sir J. Hooker and other naturalists.—*H. E. in Gardeners' Chronicle.*

THE first iron-clad battle ship of the Chinese navy, the Ting-Ynen, or Everlasting Peace, is a turret corvette of the first rank, with compound armor of English steel and iron. Both turrets are armed with twelve-inch compound plates, and the four 30½ centimeter guns which they have can deliver broadsides simultaneously. On the deck, in addition, are eight other guns from Herr Krupp's foundry at Essen.

VINES.

By J. T. STEWART.*

WHAT constitutes life is unknown. The limits of life are not clearly defined. But one thing is known—that life, in all its manifestations, is essentially the same. The distinction between animal and vegetable is, in the main, broad and distinct; but the two orders of life shade into each other as day shades into night. There are multitudes of forms that cannot be classed with the one or the other; they partake of the nature of both. Formerly the power of motion alone was enough to distinguish the animal from the vegetable. Now it is well known and admitted by all that many vegetables have the power of motion. Afterwards, sensation was regarded as an infallible test. It was thought that none but animal life had sensation. Now it is known that many plants have the power or function of sensation. Whether this manifestation of sensation is purely mechanical, or whether it is actually nerve-force in plants, is not known; but that it exists, and in some plants in a high degree, is no longer disputed.

We have now in the vegetable kingdom clearly demonstrated two of the attributes of the animal kingdom, viz.: motion and sensation. What other great lines of distinction may in the future be swept away none can tell. The great army of laborers in the field of science, by patient toil, is slowly revealing to an incredulous world the mysteries of nature. When, after incredible labor, one fact after another is demonstrated and made clear as the sunlight, men, who before ridiculed the idea, wonder that it had not been known long before, and that any one could be found stupid enough to dispute it. Yet this is the way science has always advanced, and probably always will.

We do not propose to bring forth any startling revelations to-night, or much that is original. But we do propose to lay before you some facts of recent discovery, on a very humble subject in science, that are very curious, and, to me, extremely interesting. They relate to the habits and movements of vines.

Vines are plants, either herbaceous or woody, which, without a fixed support, are unable to maintain themselves in an upright position. There are two principal methods by which they cling to this object; one is by winding spirally around it, the other is by clasping it with their leaf stalks, with tendrils, rootlets, or hooks; the former are called twiners, the latter climbers. There is another and smaller class of vines that meander round among bushes and brush for support, and still another that is prostrate and never or rarely rises above the ground. Perhaps one tenth of the species of our flora are vines, but individually the proportion is much smaller.

Twining vines wind either from right to left or from left to right; the most of them from right to left. This habit is fixed and cannot be changed. To make a vine that winds from right to left wind in the opposite direction is impossible and *vice versa*.

Twiners and climbers are endowed with sensitive organs, and a greater degree of motion than most other plants. When a twining vine springs from the ground the first few internodes are upright and have no motion, but as it grows taller it bends to one side, and the upper three or four internodes begin to revolve, either from right to left or from left to right, as the vine naturally twines. This revolving motion continues until the vine strikes some object, around which it twines. As the vine grows and new internodes form, the older ones lose this power of motion, as it is only a few of the upper internodes that revolve. Some vines in these revolutions sweep a circle of three feet in diameter. Any object within this circle is seized upon for support. The swaying of the vine by the wind often greatly increases this circle. The young leaves, before they are open, point directly forward and lie parallel with the vine, but as they open they change their position, turning backward till the leaf stems are at right angles with the vine. They do not stop there, but continue turning backward until they stand at an angle of about 135°. When the leaves become older and this part of the vine has ceased to move, they return forward till they again reach a right angle with the vine, in which position they become permanently fixed. Thus, while the vine is revolving, seeking an object for support, the leaves point backward, serving as hooks to hold to that object until the vine makes a turn around it. The time required to make one of these circles varies much in different species and considerably in the same species. The condition of the atmosphere affects this motion. The motion is more rapid in a vigorous vine than in one that is not.

On the movements of vines Charles Darwin made many observations, some of which I will give.

The Humulus Lupulus—the common hop vine—he found—left to right:

April 9,	Two circles made in	4	hours	16	minutes.
Aug. 13,	Third circle made in	2	"		
" 14,	Fourth "	"	2	"	20	"
" "	Fifth "	"	3	"	16	"
" "	Sixth "	"	2	"	2	"
" "	Seventh "	"	2	"		
" "	Eighth "	"	2	"	4	"

The Akebia Quinata moves from right to left:

March 17,	First circle made in	4	hours	0	minutes.
" 18,	Second "	"	1	"	40	"
" "	Third "	"	1	"	30	"
" 19,	Fourth "	"	1	"	45	"

The Wistaria Chinensis moves from right to left:

May 13,	First circle made in	3	hours	5	minutes.
" "	Second "	"	3	"	20	"
" 16,	Third "	"	2	"	5	"
" 24,	Fourth "	"	3	"	21	"
" 25,	Fifth "	"	2	"	37	"
" "	Sixth "	"	2	"	35	"

The Lapagera Rosa moves from left to right:

March 9,	First circle made in	26	hours	15	minutes.
" 10,	Semicircle "	"	8	"	15	"
" 11,	Second circle "	"	11	"		
" 12,	Third "	"	15	"	30	"
" 13,	Fourth "	"	14	"	15	"
" 16,	Fifth "	"	8	"	40	"

This circle was made when the plant was placed in the hot-house.

He gives many other observations, but these are enough to enable us to form some idea of the velocity of these movements in different plants and their variation in the same plant.

I observed this circular movement last summer in my morning glory vines, and, without timing them accurately, found that they usually made about two circles during the day. Their internodes are long when the vine is growing rapidly, and I noticed that they often swept a circle of two feet in diameter, and sometimes more. The shortest time in which Darwin observed any plant to make a revolution was that of the Scypanthus—one hour and seventeen minutes; the longest, that of the Adhadata, which sometimes required forty-eight hours. He says, under similar circumstances the rate of movement in the same species is tolerably uniform, but many circumstances accelerate or retard it. Plants of the same order almost uniformly twine in the same direction; but there are exceptions to this rule, as there are to almost all other rules. Darwin has found one exception, but he has seen no instance of species of the same genus twining in opposite directions; yet Fritz Muller states that "although the Mikania Scandens twines, as I have described, from left to right, another species, in Brazil, twines in an opposite direction." And Dutrochet says that "individuals of the Solanum Dulcamara revolve and twine in two directions; this plant, however, is a most feeble twiner." The Loasa Aurantica has been observed by Leon to twine—some in one direction and some in the other; and others, again, to revolve and twine first in one direction and then reverse their course. A few other vines have been observed to revolve first in one direction, then reverse their course for a few revolutions, and twine in the opposite direction, and to continue these changes in their course every few revolutions during their growth. Another thing I have observed about twining plants, which is worthy of note, is their inability to twine around large objects. Some are able to twine around larger objects than others, but very few in this country are able to twine around an object more than three or four inches in diameter. Four years ago I set a Menispermum Canadensis, which is a vigorous twiner, at the root of a little box elder tree. This tree could not have been more than one and a half inches in diameter; my vine grew rapidly and spread all around the root of the tree, but would not ascend. I wound some of the vigorous shoots around the tree and tied them; this operation I repeated several times, but could not make the vine make one turn around—it was not able to do so. I was much perplexed at this, and having several of the same vines in different parts of my yard, I noticed that all of them that rose above the ground twined around smaller objects; they had done so when the bush was slender, and retained their hold as it grew larger, some of them being almost buried in the wood by the growth of the bush, but I could find none that was actually twining around an object more than an inch and a half in diameter. Some other plants will twine round a much larger object, but all have their limit of capacity, beyond which they are utterly unable to twine. The Menispermum Canadensis is as incapable of making a single turn around an object three inches in diameter as it is of maintaining itself in an upright position without support.—*Pharmacist.*

* Read before the Peoria Scientific Association.

NEW ZEALAND FUNGUS.

CONSUL GRIFFIN, of Auckland, states that among the various products of New Zealand, that of fungus has, within the last few years, attracted a considerable amount of public attention. It was not deemed of sufficient importance to be included in the list of colonial exports until 1872, but since that year the annual shipments have steadily increased. The export of New Zealand fungus appears to be confined to one species, the *Hirneola polytricha*, although there are some very rare varieties, bearing a close resemblance to it, found in the neighborhood of Christchurch and Wellington, specimens of which were sent to the Vienna Exhibition under the name of Jew's ear fungus; these specimens may be easily distinguished from the *Hirneola polytricha* by the color, the former being of a pinkish tint, while the latter is of a grayish hue. The inside of the leaf of the *Hirneola polytricha*, when dried, is a dark, reddish brown, while the outside presents glossy gray or dove color; the leaf is shaped like a saucer, and varies in size from three to seven inches in diameter. It is flabby in appearance, rough to the touch, and of considerable strength. This fungus is found upon various kinds of decayed timber in the North Island, in what are called new bush settlements. It is more abundant in damp localities, and is very plentiful on the east coast, south of the East Cape, but it exists in the greatest abundance in the province of Taranaki. This province is about 80 miles long and 70 broad. It is bounded on the north by the River Mokan, on the west and south by the sea, and on the east by a straight line from the mouth of the Patea River, to a bend in the Wanganui River, and by another straight line connecting the latter river with the source of the Mokan. Within this region are vast forests; in fact not more than one-tenth of the entire province is composed of open land.

The process of clearing the ground is very slow, and the settlers often find their task so difficult that they abandon their work in one place and begin again in another. They lop off the branches of the trees and burn them, leaving the logs upon the ground, and these soon begin to decay. The trees are well supplied with spurs, and fall in such a way as to partially rest upon them within a few feet of the ground. Sometimes the workmen erect a scaffold for the trees to fall upon. It is supposed that the trees being left in this way favor the growth of fungus. It appears that very little trouble, and no expense, is required to prepare this valuable article of commerce for the market, the only thing necessary being to gather it and spread it out on the ground in the open air or under sheds to dry. This is generally done by children, who make a good living in collecting it. Very few men, except those of idle and dissipated habits, engage in the employment of collecting fungus, with the exception of the Maories. The fungus collected by the natives is generally dried in smoky huts, and is on that account not so valuable as that prepared by Europeans.

As soon as it is dried it is put in flax baskets or jute bags, and sold to the dealer. It is then packed in bales and shipped to China by way of Sydney or San Francisco. Some of it goes direct to San Francisco, where it is either transshipped to China or consumed by the Chinese population of the Pacific coast. At one time the profit upon fungus was very great, as it could be bought from the collectors at little more than ½d. per pound, and sold in San Francisco at 7½d. and about 1s. in Hong Kong; but now that its market value has become better known, it is difficult to purchase it in New Zealand, even in small lots, from the collectors, for less than 4d. to 5d. per pound.

In 1873, the New Zealand Government caused an inquiry to be made as to the purpose for which fungus is used in China; and it appeared, from the report of the Colonial Secretary of Hong Kong, that the article was much prized by the Chinese community as a medicine administered in the shape of a decoction to purify the blood, and also as an article of food, as it forms the chief ingredient of their favorite soup, it being much prized on account of its gelatinous properties and its rich and delicious flavor. It is also used in China and Japan for making a valuable dye for silks.—*Journal of the Society of Arts.*

PREHISTORIC KNIVES.

MR. GEORGE F. KUNZ exhibited recently to the New York Academy of Sciences a remarkable series of prehistoric knives, flakes, and cores, of obsidian, from the vicinity of the city of Guatemala, Central America. They were obtained by the partial cutting away of a mound during the making of a new road about six miles from the city. The excavation revealed a sort of little cyst or chamber, walled and roofed with slabs of stone or baked clay, within which this large quantity of obsidian knives had been carefully and quite regularly laid away. There was scarcely anything else in the chamber, but the broken and worn edges of many of the implements would indicate that they had been much used; and the suggestion is strong that this may have been a sacrificial mound, and that these were the implements used in the rites of sacrifice, perhaps, for a long period.

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